World Premier International Research Center Initiative (WPI)

FY2014 WPI Project Progress Report (Post-Interim Evaluation)

Host Institution	Kyushu University	Host Institution Head	Chiharu Kubo
Research Center	International Institute for Carbon-Neutral Energy Research (I^{2}CNER)	Center Director	Petros Sofronis

Common instructions:
* Unless otherwise specified, prepare this report from the timeline of 31 March 2015.
* So as to base this fiscal year's follow-up review on the document "Post-interim evaluation revised center project," please prepare this report from the perspective of the revised project.
* Use yen (¥) when writing monetary amounts in the report. If an exchange rate is used to calculate the yen amount, give the rate.

Summary of State of WPI Center Project Progress (write within two pages)

As we embark upon I^{2}CNER's second term, our principal goal is to establish the I^{2}CNER brand worldwide through international, collaboration-driven transformational scientific advances which will lead to a carbon-neutral energy society. I^{2}CNER's success in establishing this pinnacle will be determined by the international community's perception of the degree of I^{2}CNER's success as a test bed for internationalization of scientific research and education in Japan, the U.S., and across the world. To achieve this international acclaim, I^{2}CNER is tackling the key scientific challenges that define the path toward a carbon-neutral energy Japan and the establishment of sustainable energy supplies using limited energy resources. We believe that the requisite foundation and infrastructure for I^{2}CNER to fully realize this global brand has been catalyzed during its first term.

Conducting research of the highest world level: Evidence of I^{2}CNER's growing international stature and relevance can be seen in its 318 journal publications in FY 2014, of which, 28 were published in journals with an impact factor greater than 10. This accomplishment demonstrates a steadily increasing rate of the Center's productivity over the years (53, 150, 263, and 318, respectively in FY 2011, 12, 13, and 14). On a related note, since its inception, 117 of the Institute's publications have been cited 10 or more times, 42 have been cited 20 or more times, 20 have been cited 30 or more times, 10 have been cited 40 or more times, and 4 have been cited 50 or more times. In addition, we filed for 10 patents (7 of which are from the Fuel Cells division via the NEXT-FC center and within the Center-Of-Innovation Program).

In addition to being aligned with the roadmap scenarios for a carbon-neutral energy Japan developed by the Energy Analysis Division (EAD) of I^{2}CNER, each I^{2}CNER research effort has been focused so that it serves the objectives of the corresponding project in the division roadmap, and is aimed at the specific milestones that are identified on the division roadmaps. The roadmaps themselves have been updated to consolidate and focus our research effort as a whole, ensuring that they include ultimate targets and benchmarks, and, wherever possible, that long-term milestones have been converted into mid-term milestones.

The research activities of FY 2014 are as follows: PI Ishihara's group's discovery of a different surface composition of perovskite materials used in electrochemical cells is transforming the way we understand the operating principles of these materials in hydrogen production devices. In collaboration with the Ishihara group, Illinois Prof. X. Li has applied her remarkable MacEtch process for highly anisotropic wet etching of semiconductors to the fabrication of unique nanostructures that can potentially serve as an outstanding material for photo electrochemical cells. In the area of hydrogen compatible materials, PIs Robertson and Sofronis revealed a continuously changing microstructure by hydrogen. This result indicates future directions for development of physically-based model of hydrogen-induced degradation of metals. In addition, the Takaki group demonstrated the hydrogen compatibility of ultra-fine grained stainless steels, a crucial milestone in establishing the technological viability of these steels. This advance holds promise for reducing hydrogen fuel system costs by replacing the current low-strength, high-nickel steels (e.g., SUS316). Through a highly collaborative effort, Illinois Professors Kenis and Gewirth and Kyushu Prof. Nakashima, who is a world expert on stabilizing Pt-based electrocatalysts on carbon nanotubes, managed to electrochemically reduce CO_2 to CO with the lowest potential reported in the literature, and with current densities approaching those required for practical applications. The CO_2 Capture and Utilization division demonstrated that flue gas from a power plant can be used directly as the feed for electroreduction of CO_2 to CO, thus eliminating the energy intensive process of CO_2 separation from the flue gas. In the area of Fuel Cells, advances by the Sasaki group in Fe/N metal-free electrocatalysts have the potential of impacting PEFCs, due to their remarkable durability and superb performance over 60,000 potential cycles in alkaline solution; the importance of this accomplishment can be better captured if we consider that the recently released Toyota Mirai car uses the expensive Pt/Co for its catalyst. Working with Illinois Professor Cahill, the Takata and Horita groups managed to reduce the thermal conductivity of silicon by a factor of up to 20 using severe material deformation, a significant contribution if one considers that high lattice thermal conductivity prevents the use of silicon as a thermoelectric material. Prof. Takata, advancing the field of adsorbents for next generation cooling systems, developed two new and promising absorbents that exhibit the highest ethanol uptake. The group of PI Akiba is leading the development of hydrogen storage materials by synthesizing new carbon-based materials with potential capacity over 10 wt % by tailoring their microstructure to meet required performance standards. Storing hydrogen as formic acid, PI Ogo and his group have discovered a bio-inspired catalyst that converts formic acid into hydrogen; this has the revolutionary potential to define a process to store hydrogen as a liquid under atmospheric conditions. The group of PI Katsuki, building on previous catalytic aerobic oxidation results with the use of iron or ruthenium complexes, has accomplished the monumental task of developing non-energy requiring aerobic oxidation. PIs Tsuji and Christensen carried out numerical and experimental studies of the role of capillary, viscous, and inertial forces for CO_2 trapping in geologic formations. This concerted effort yielded a transformation in our understanding of pore-scale flow processes, particularly in terms of the inertial effects not captured in pore-scale models currently used in geologic reservoir characterization. This advances our ability to both predict reservoir viability as well as post-injection CO_2 migration.

Advancing fusion: I^{2}CNER has undertaken multiple initiatives to advance fusion research, most notably, the I^{2}CNER Competitive Funding Program for young I^{2}CNER researchers. The specific objective of this program is to foster interdisciplinary research and nurture young faculty and postdocs. The stringent criteria for this program include relevance to the I^{2}CNER roadmap and a demonstrated potential for high-impact results. Participation in the program required proposal submission from young faculty and postdocs who have neither collaborated with one another previously, nor published together over the last two years. Winning recipients of I^{2}CNER Competitive Funds are required to submit quarterly progress reports. The success of the Competitive Funding Program will be assessed at the end of FY2015.
This year's annual symposium on fuel generation and use brought together 12 prominent international scholars from disparate fields amongst the 141 total participants. Similarly, the nine international workshops run by the each of I^{2}CNER's research divisions specifically focused on the interdisciplinary aspects of their research objectives. A major outcome of the 2015 I^{2}CNER Annual Symposium and individual division workshops is that in FY 2015, I^{2}CNER plans to host a workshop to explore cross-cutting themes for computational science, including catalysis, degradation, and select defect behaviors in order to discern what computational questions/problems I^{2}CNER is best poised address in the future.

Globalization of the Institute: The addition of Prof. Fraser Armstrong of Oxford, Prof. Michael Celia of Princeton, and Mr. Mark Paster, a former energy analyst of the US Department of Energy, to I^{2}CNER's External Advisory Committee is indicative of the international standing of the Institute. As of March 31, 2015, I^{2}CNER has a total of 23 partner institutions in the US, Europe, and Asia, of which, I^{2}CNER has agreements or MOUs with 4. A notable advance in I^{2}CNER's international visibility is the conversations and exchanges of information with the Air Resources Board of the State of California (CARB), and ongoing discussions for an agreement with Helmholtz-Zentrum Geesthacht (HZG) of Germany. In addition, the second I^{2}CNER in Tokyo Symposium was held on December 12, 2014 in order to show how merging Japan and the US academic and research cultures is impacting and transforming multidisciplinary international research and academic infrastructures, and explore what can be done to improve, enhance, and accelerate the transition of our research to impactful energy solutions. The US Ambassador to Japan, Ms. Caroline Kennedy, honored I^{2}CNER by attending and giving remarks at this symposium. The Institute hosted 24 speakers (54% of which were foreign) in 22 seminars as part of the I^{2}CNER Seminar Series.
The researchers of the Institute have also had success at elevating the Institute's visibility on an individual level. By way of example, I^{2}CNER researchers hosted 42 distinguished visitors to Kyushu University from the United States, Canada, Europe, Korea, China, South Africa, Australia, France, Norway, Japan, and the United Kingdom. The Institute's researchers were responsible for organizing or co-organizing 8 international conferences, 6 international conference sessions, and 9 I^{2}CNER international workshops. Similarly, our researchers have given more than 32 keynote, plenary, and invited presentations in international conferences and fora (for a list of the 10 most significant, please see Appendix 1B). In addition, our researchers have joint publications with researchers from 26 institutions around the world. Lastly, Institute researchers are playing leading roles in international networks for advancing hydrogen research and development, e.g. PI Akiba and International Energy Agency (for full details, please see Section 3).

Implementing organizational reforms: In support of the vision of Prof. Chiharu Kubo, KU's new President, the KU Administration has awarded I²CNER 3 tenured positions (2 associate professors and 1 professor) through the University Reform Revitalization Program in FY 2014. Two of these positions must be used to hire foreign faculty into the Institute. In view of the success of Prof. Sofronis' cross-appointment between Kyushu University and the University of Illinois, KU institutionalized a university-wide cross-appointment system in March 2015. Mr. Shunichi Masuda was appointed as the new Administrative Director, with a mandate to execute President Kubo's vision toward the goal of realizing the WPI mission within KU. Mr. Masuda's extensive experience working in industry, both in the US and Japan, makes him an ideal candidate for this position. I²CNER provides an unparalleled opportunity for many permanent Kyushu University employees, especially those who serve in the Institute's Administrative Office, to strengthen their English language skills, which can then be used in subsequent posts at KU. By way of example, a former I²CNER Associate Administrative Director was promoted to the Head of the International Student Exchange Division of the International Affairs Department as of September 1, 2014. These actions as well as the commitment from KU demonstrate the impact of the Institute in guiding institutional reform.

Others In FY 2014, I²CNER took major steps to increase its international visibility. The most notable of these steps may be the strengthening of the relationship between Kyushu University and the University of Illinois at Urbana-Champaign (UIUC). Specific actions to promote interaction between I²CNER and the I²CNER Satellite included a visit by UIUC Chancellor Phyllis Wise to Kyushu University; the signing of an Agreement on Academic Cooperation between the two universities on May 26, 2014; the signing of an Undergraduate Exchange Agreement on October 24, 2014; preliminary negotiations for a Revised Satellite Agreement, which will be finalized by November 2015; the hosting of 6 undergraduate exchange students from Kyushu University's Faculty of Engineering at UIUC from February 23-March 25, 2015; and a coordinated effort between the two universities to submit a joint pre-proposal to the NSF/JSPS Partnerships for International Research and Education (PIRE) program (the full proposal for this effort will be submitted on May 15, 2015).

・Please concisely describe the progress being made by the WPI center project from the viewpoints described below.
・In addressing the below-listed 1-6 criteria, please place emphasis on the following:
(1) Whether research is being carried out at a top world-level (including whether research advances are being made by fusing fields).
(2) Whether a proactive effort continues to be made to establish itself as a "truly" world premier international research center.
(3) Whether a steadfast effort is being made to secure the center's future development over the mid- to long term.
・Please prepare this report within 10-20 pages (excluding the appendices, and including Summary of State of WPI Center Project Progress (within two pages)).

1. Conducting research of the highest world level

* Regarding the criteria used when evaluating the world level of center, please note any updated results using your previous evaluation criteria and methods or any improvements you have made to those criteria and methods.

Evidence of I^2CNER's growing international stature and relevance can be seen in its 318 journal publications in FY 2014, of which, 28 were published in journals with an impact factor greater than 10. In fact, the Institute's rate of productivity is steadily increasing (53, 150, 263, and 318 publications in FY 2011, 12, 13, and 14, respectively). On a related note, since its inception, 117 of the Institute's publications have been cited 10 or more times, 42 have been cited 20 or more times, 20 have been cited 30 or more times, 10 have been cited 40 or more times, and 4 have been cited 50 or more times. In addition, in FY 2014, I^2CNER researchers received 50 national and international awards (including best poster presentations) from various societies and institutions, including Prof. T Kunitake's 2014 Order of Culture; Prof. Tsuji's award from the Seismological Society of Japan; Dr. A. Nagao's award from the Japan Institute of Invention and Innovation; Dr. H. Téllez-Lozano's award from 11th European SOFC&COE FORUM 2014; and Dr. B. P. Somerday's award from the U. S. Department of Energy. As an Institute, in FY 2014, we realized 4 of the short term milestones in our division roadmaps and made significant progress toward 5 milestones in other projects. We filed for 10 patents (7 of which are from the Fuel Cells division via the NEXT-FC center and within the Center-Of-Innovation Program). We hold agreements with 4 internationally recognized research centers/universities (SINTEF/NTNU, Illinois, CARB, and NFCRC) and ECOSTORE, a consortium based in the European Union.

In FY2014, I^2CNER hosted 3 international symposia, and held 16 seminars in the Institute Interest Seminar Series and 22 seminars in the I^2CNER Seminar Series. The Institute's researchers were responsible for organizing or co-organizing 8 international conferences, 6 international conference sessions, and 9 I^2CNER international workshops. In addition, our researchers have joint publications with researchers from 26 institutions around the world. Our researchers have given more than 59 keynote, plenary and invited presentation in international conferences and fora (for a list of the 10 most significant, please see Appendix 1B).

The relevance of the I^2CNER research efforts and objectives to enabling the green innovation initiative of the government of Japan is demonstrated by the large number (49) of collaborative projects in which its researchers are involved with industry (10 of these are within the NEXT-FC center). The following <u>four projects resulted in technology transfer events</u>: i) Prof. Horita's collaboration with Nagano Forging Co. Ltd to build an HPS (High-Pressure Sliding) facility with a maximum capacity of 500 tons, which is an upscaling of his laboratory facility; ii) Innovative surface-wave analysis to estimate localized heterogeneities in the Tomakomai CO_2 injection site has been provided by Prof. Tsuji to Japan CCS Corporation to help with the decisions on the suitability of drilling site locations; iii) Prof. Tsuji provided the Shikoku Research Institute, INC. & Shikoku Electric Power Co. INC. with a new approach to estimate earthquake intensity at their plants using conventional seismic data; and iv) Acting Lead PI of the EAD, Prof. Itaoka, is working on model development for hydrogen refueling stations and supply infrastructure for Toyota Motor Corporation (Geographical allocation in metropolitan areas and business model for refueling stations). <u>Other projects that may result in technology transfer</u> (commercial application) are: i) (Hydrogen Materials Compatibility Division) The development of a weld joint of XM-19 tubes for cost reduction of hydrogen refueling stations, Air Liquide Laboratories—results may lead to commercialization of weld joints and gases for welding; ii) (Hydrogen Materials Compatibility Division) the inhibition of hydrogen embrittlement of pipeline materials by addition of impurities, Air Liquide Laboratories—results may lead to commercial application of chemical inhibitors; iii) (Hydrogen Storage Division) the development of rare-earth free AB_2 alloys for negative electrode of Ni-MH battery in collaboration with Panasonic Corporation—may result in a technology transfer event; and iv) (Catalytic Materials Transformations) Collaboration with DAIHATSU Motor Co., Ltd., Japan New Chisso Co., Ltd, and MITSUBISHI Chemical Co., Ltd within the framework of Fukuoka Industry-Academia Symphonicity to develop functional Pt-free molecular catalysts and biocatalysts for H_2 activation for low-cost hydrogen fuel cells.

The Institute's best accomplishments by division are as follows:
i) Hydrogen Production: Demonstration by the Ishihara group and collaborators of a different surface composition of perovskite materials used in electrochemical cells is changing the way we understand the operating principles of these materials in hydrogen production devices; the Adachi group has synthesized rare-metal free molecules that make light from nearly all current injected into organic light emitting devices for the first time, greatly advancing the methods for making high-efficiency organic light emitting devices.
ii) Hydrogen Materials Compatibility: Current hydrogen-induced degradation models assume an invariant material microstructure, but the Institute's recent results demonstrate a tangible step toward incorporating the observed hydrogen-induced dislocation microstructure evolution in a predictive, physics-informed model; demonstrating the hydrogen compatibility of ultra-fine grained (UFG) stainless steels is a crucial milestone in establishing the technological viability of these steels, which hold promise for reducing hydrogen fuel system costs by replacing the current low-strength, high-nickel steels (e.g., SUS316).
iii) Fuel Cells: Our research results in the chemomechanics of fuel cells provides a novel path forward to design durable oxides for next-generation solid oxide fuel cells, solid oxide electrolysis cells, gas separation membranes, and high temperature sensors, all with long lifetimes; whereas the recently-commercialized Toyota Mirai car uses Pt/Co for a catalyst, our advances in Fe/N metal-free electrocatalysts have the potential of impacting PEFCs, due to their remarkable durability and superb performance over 60,000 potential cycles in alkaline solution.
iv) Thermal Science and Engineering: Our newly synthesized adsorbent, based on spherical phenol resin treated with different mass ratios of KOH, can make waste-heat driven refrigeration systems more efficient, thus contributing drastically to the reduction of CO_2 emissions.
v) Hydrogen Storage: Hydrogen storage capacity over 10 wt % can be achieved by lightweight borohydrides and TiFe can be used to store renewable energy efficiently and cost-effectively.
vi) Catalytic Materials Transformations: Bio-derived [NiFe]Hydrogenase from citrobacter sp. S-77 natural catalyst is more active and potentially far cheaper than platinum as an electrode for H_2 oxidation reaction; Developed a catalyst for burning renewable fuels without generating carbon dioxide, underpinning green power generation technologies.
vii) CO_2 Capture and Utilization: Use of an IrO_2 catalyst instead of the much more costly Pt catalyst as an anode in a CO_2 electrolyzer flow cell improved current densities for CO production to over 250mA/cm^2 and energetic efficiencies to over 70% (an increase in efficiency of 40% over the use of Pt).
viii) CO_2 Storage: Numerical and experimental studies of the role of capillary, viscous, and inertial forces for CO_2 trapping yielded a transformation in our understanding of pore-scale flow processes, particularly in terms of the inertia effects not captured in pore-scale models currently used in reservoir characterization. This advances our ability to predict both reservoir viability and post-injection CO_2 migration. Detection of localized heterogeneity in the geological formation of the Tomakomai CO_2 capture and storage site advances our ability to characterize candidate storage reservoirs marked by heterogeneous rock formations—a key challenge towards fully realizing accurate characterization of candidate storage reservoirs, as well as monitoring and predicting CO_2 fate at the field scale in heterogeneous rock formations.
ix) Energy Analysis: Cost analysis of the I^{2}CNER scenarios indicates that the overall cost benefits that we gain from the implementation of renewables hinges upon new research and technology for the integration of renewables into the grid.

In the following, the Institute's best accomplishments are described in more detail:

Hydrogen Production (Lead Principal Investigator: Prof. Ishihara)

The research in this division falls under the themes of energy production, conservation, and storage. Energy production is based on the conversion of solar to electric energy, storage is achieved through hydrogen fuel, and conservation is achieved through enhanced lighting efficiency based on high efficiency solid state lighting. Unique aspects are techniques for the analysis of the interface structure of organic dye and inorganic semiconductors, experimental materials synthesis, device fabrication and testing, and theory-based materials development. Projects encompass novel inorganic and organic photocatalysts and electrodes, synthesis of novel molecules for organic light emitters and photoelectrochemical and photovoltaic cells, and materials for electrochemical and electrolytic water reduction. As a complement, organic light emitting devices are being developed for high efficiency lighting for energy conservation. Selected results are:

Novel Surface Compositions of Perovskite Oxide Electrode Fuel Cell Materials

Our work has shown that after exposure to elevated temperatures, the surfaces of solid oxide electrode materials for electrolyzers (SOECs) and fuel cells (SOFCs) universally show a surface dominated by alkaline earth cations, with the transition metal (assumed to be the catalytically active site) absent. Although absent from the very outer layers, the transition metals are, however, enriched in a subsurface layer (see Fig. 1.1). Furthermore, this rearrangement occurs very rapidly and at relatively low temperatures. This improvement in our understanding of the surface composition of solid oxide electrode materials was achieved mainly through the application of a unique surface analytical technique, Low Energy Ion Scattering (LEIS) spectroscopy, which selectively probes the composition of the very outer atomic surface of a material.

This is a significant accomplishment for I^2CNER, because it challenges the prevailing consensus about the surface composition and oxygen exchange properties of solid oxide electrodes – most models assume transition metals are present in the very outer surface, which is disproved by our results. There is currently no model explaining how a surface such as SrO, which we typically observe, can facilitate the oxygen reduction reaction, which is critical to device performance. Our findings are already guiding computational studies both with Profs. Staykov and Ertekin within I^2CNER, and groups at other international institutions.

The achievement represents a revolution in our understanding of the surface composition of the materials of interest, and contributes to the short-term milestone of the Hydrogen Production Division Project 1-1 (High Temperature Electrolysis), to improve the energy efficiency of electrolysers working at 500 °C. The understanding of changes in surface composition with time also contributes to the overall target of increasing durability to 0.5% degradation per 1000 hours.

Key Publications for this work

J. Druce, H. Téllez, M. Burriel, M.D. Sharp, L.J. Fawcett, S.N. Cook, D.S. McPhail, T. Ishihara, H.H. Brongersma, J.A. Kilner, Surface Termination and Subsurface Restructuring of Perovskite-Based Solid Oxide Electrode Materials, Energy and Environmental Science, vol. 7, iss. 11, pp. 3593 – 3599, 2014.

H. Téllez, J. Druce, Y.-W. Ju, J. Kilner, T. Ishihara, Surface chemistry evolution in $LnBaCo_2O_{5+\delta}$ double perovskites for oxygen electrodes, International Journal of Hydrogen Energy, vol.39, pp. 20856 – 20863, 2014.

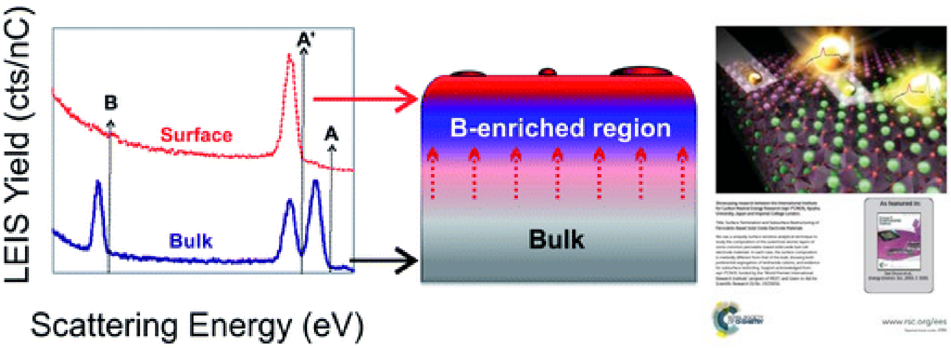


Fig. 1.1. Low energy ion scattering [LEIS] data (left) showing peaks due to Ba (peak A*), Gd (peak A), and Co (peak B) related to the surface and bulk composition of $GdBaCo_2O_{5+\delta}$. The surface of the sample shows only Ba indicating a surface consisting entirely alkali earth cations. The underlying region is enriched in the transition metal (for example Co; middle schematic figure). The right hand figure shows an artists conception of LEIS experiment here featured on the cover of the journal issue.

Design of Metal-free Fluorescent/Phosphorescent Blends for High Efficiency Light Emission

Organic materials exhibiting thermally active delayed fluorescence (TADF) show great promise as emitters in organic light-emitting diodes (OLEDs) for application to highly-efficient and low-cost lighting and displays and have reached internal quantum efficiencies (IQE) of 100% in some cases. By enabling the conversion of triplets into singlets for emission by fluorescence in a purely organic molecule, TADF emitters overcome some of the limitations of fluorescent materials. The latter are restricted to an IQE of 25% because only one-fourth of electrically-generated excitons are formed as light-emitting singlets. Phosphorescent materials typically require expensive rare-earth metals to utilize the three-fourths of excitons generated as triplets. However, TADF materials still suffer from short operational lifetimes and strong efficiency roll-off at high brightnesses.

One key cause of these issues is the large population of long-lived triplets in OLEDs using TADF emitters. The triplets participate in degradation reactions and exciton annihilation processes. The large triplet population partially results from a relatively slow rate of fluorescence (kf) in most TADF emitters compared to conventionally fluorescent emitters. Although a small energy difference between the triplet and singlet states (ΔEST) enables the triplets in TADF materials to up-convert into singlets by absorbing thermal energy, the low kf allows singlets to down-convert back into triplets before emission, leading to multiple conversion cycles, a higher population of triplets, and a longer exciton lifetime.

To confront these issues, we have pursued two routes in parallel. On the one hand, we have synthesized new blue TADF emitters with increased fluorescent emission, while maintaining a small singlet-to-triplet energy state difference. We have thus achieved a maximum external quantum efficiency (EQE) of 21%. This was accomplished by developing new molecular design guidelines based on relationships between molecular structures and properties. On the other hand, we were able to achieve 100% IQE with improved molecular lifetimes by devising a new system that uses conventional fluorescent materials as emitters and TADF molecules as assistant dopants to convert the non-emitting triplets into singlets before transfer of the energy to the fluorescent emitters.

For the development of new blue emitters, we systematically studied the relationships between computationally modeled and experimentally measured properties for a series of molecules (Fig. 1(a)). The energy separation of the highest occupied molecular orbital (HOMO) and lowest unoccupied molecular orbital (LUMO), used to minimize the energy difference between the singlet and triplet states, often leads to a small fluorescence emission rate. From this investigation, we found that a small energy difference can be maintained while increasing fluorescence by delocalizing the HOMO and/or LUMO over a larger volume.

Through this study, we developed a new blue TADF emitter with a peak electroluminescence (EL) wavelength of 478 nm and ηEQE of 16.8%, which corresponds to an ηIQE of 84%. For a material with a greener blue emission (peak EL wavelength of 487 nm), an even higher ηEQE of 20.6% was achieved (Figs. 1.2 (b) and (c)). The high efficiencies are attributed in part to the high fluorescence rate in these materials, reducing the number of singlets that go through multiple cycles before emission. This reduces the triplet population. The new molecules are an important step toward efficient blue emitters, which are important for full-color displays but have been difficult to realize with TADF materials. Furthermore, these guidelines for the design of TADF molecules will aid in the development of new materials.

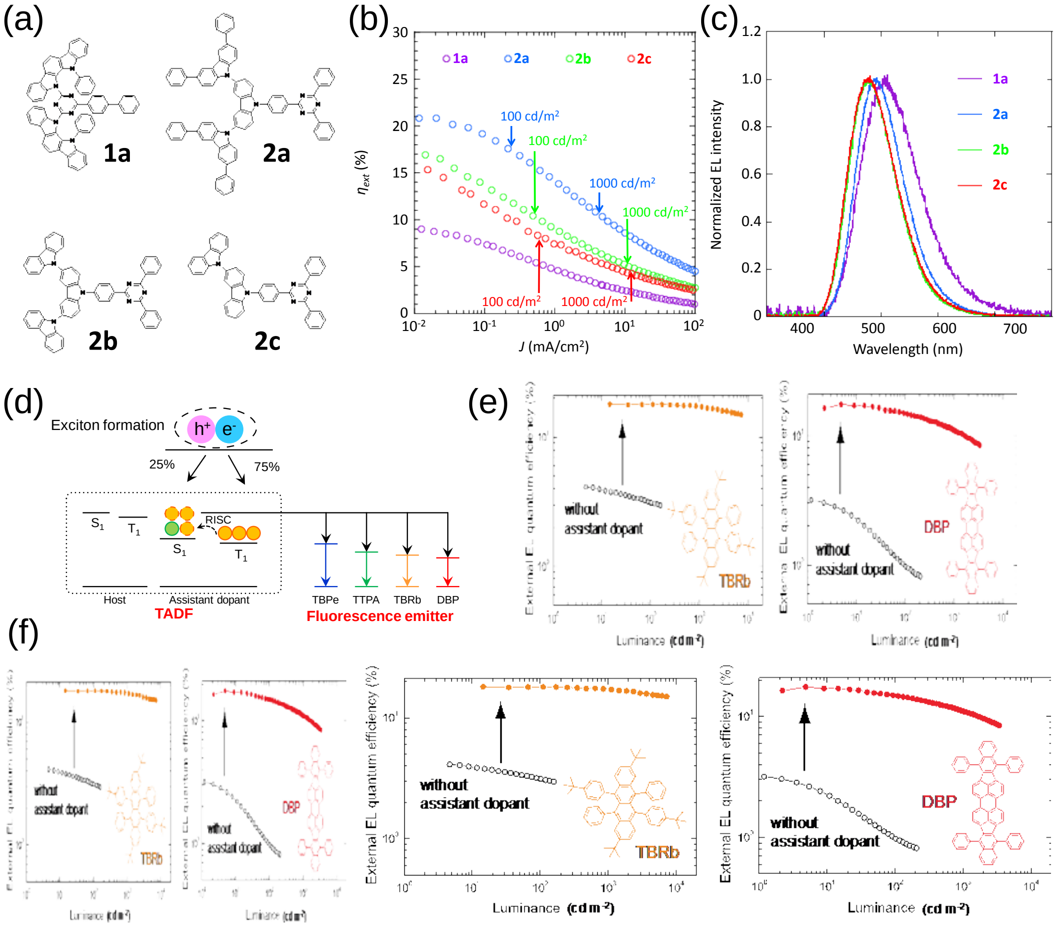


Fig. 1.2. (a) Chemical structures of the studied materials. The degree of HOMO delocalization increases from compound **2c** down to **2a**. (b) External quantum efficiency vs. current density (*J*) characteristics for OLEDs using the TADF materials as emitter. (c) Emission spectra of the OLEDs. (d) Working mechanism of the TAF system. (e) Emission spectra for four different TAF OLEDs using different fluorescent emitters. (f) Output characteristics for three of the TAF OLEDs with (filled shapes) and without (empty shapes) the fluorescent emitter. The assistant dopants for the TBPe, TTPA, TBRb, and DBP devices were ACRSA, ACRXTN, PXZ-TRZ, and Tri-PXZ-TRZ, respectively.

In our second route, we exploited the higher fluorescence rate, better stability, and color purity of conventional fluorescent organic molecules while using our TADF materials to harvest nearly 100% of excitons. In our system, which we call TADF-assisted fluorescence (TAF), excitons are formed and converted into triplets on the TADF materials before being transferred to conventional fluorescent emitters doped into the same film (Fig. 1.2 (d)). The fast nature of singlet energy transfer from TADF to fluorescent materials and the high fluorescence rate of conventional fluorescent materials, which exceeds that of TADF materials, reduces the triplet population by rapid shuttling of the singlets to the fluorescent materials for quick radiative decay before they can convert back into triplets. The use of a conventional fluorescent material also improves the color purity of emission and enables the realization of additional colors using existing materials without the development of new TADF emitters.

To realize this system, we first selected candidate materials from our inventory of developed TADF materials and known fluorescent materials with properties suitable for energy transfer and high emission efficiency. After identifying and optimizing material combinations exhibiting energy transfer based on photoluminescence measurements, we applied the best combinations to devices. We achieved EQE of 13%-18% from blue, green, yellow, and red fluorescent emitters, as shown in Figs. 1.2 (e) and (f). These correspond to maximum power efficiencies of 47 and 58 lm/W for green and yellow emission, respectively, and an IQE approaching 100% for yellow and red emission. Furthermore, comparison of TADF-based and TAF-based OLEDs showed an approximately five-fold increase in half-brightness operational lifetime to 194 h by inclusion of the fluorescent emitter in the yellow device. Although small-area devices (1 mm^2) for ease of fabrication and testing were used here, these results are a step toward our short-term milestone of achieving power efficiencies of over 80 lm/W in 5 cm × 5 cm devices (benchmark of 131 lm/W) and long-term goal of half-brightness lifetimes surpassing 10,000 h.

This work can be seen as a progression of our previous work for harvesting triplets for light emission without the use of phosphorescent materials containing heavy metals that started with the development of TADF emitters. The new blue TADF emitters and design guidelines are the result of a continued deepening of our prior studies on TADF emitters and will advance the design of new TADF materials as both emitters and assistant dopants. The TAF system branches off from our previous work by utilizing the TADF materials for a different role. In addition to improvements in stability and efficiency relative to TADF and conventional fluorescence, respectively, our new route also enables the realization of highly-efficient emission with various colors from a wide-range of existing fluorescent materials using already-developed TADF materials. For these reasons, this accomplishment has great potential for the further development of highly-efficient lighting and displays based on OLEDs.

Publications

S. Hirata, Y. Sakai, K. Masui, H. Tanaka, S.Y. Lee, H. Nomura, N. Nakamura, M. Yasumatsu, H. Nakanotani, Q. Zhang, K. Shizu, H. M., C. Adachi, Highly efficient blue electroluminescence based on thermally activated delayed fluorescence. Nature Materials, vol. 14, pp. 330-336, 2015.

H. Nakanotani, T. Higuchi, T. Furukawa, K. Masui, K. Morimoto, M. Numata, H. Tanaka, Y. Sagara, T. Yasuda, C. Adachi, High-efficiency organic light-emitting diodes with fluorescent emitters, Nature Communications, vol. 5, no. 4016, 2014.

Hydrogen Materials Compatibility (Lead Principal Investigator: Dr. Somerday)

The goal of this division is to provide the basic science that will enable optimization of the cost, performance, and safety of pressurized hydrogen containment systems. In particular, the objectives include: development and use of advanced methods for experimentally characterizing the effects of hydrogen on the fatigue, fracture, and tribological properties of materials; development of models of hydrogen-affected fatigue, fracture, and tribo-interfaces; and development of next-generation monolithic and functionally graded materials having lower cost and improved performance (e.g., higher strength) while retaining resistance to hydrogen-induced degradation. Selected representative results are:

Effect of hydrogen-induced microstructure evolution on the mechanisms of fracture.

The integrated scientific achievements described below represent progress toward the milestone of identifying mechanisms for hydrogen-induced fracture mode transitions in ferritic and austenitic alloys, considering the role of hydrogen-induced microstructure evolution. This short-term milestone is featured in the division Project 1: Physical Descriptions of Hydrogen-Materials Interactions.

In previous accomplishments, hydrogen-affected deformation was implicated as a contributing factor to hydrogen-induced degradation of structural metals. For example, it was suggested that hydrogen-induced cracking at grain boundaries in nickel was promoted in part by hydrogen-affected deformation. One objective for Project 1 is to explore a potential link between hydrogen-affected deformation and hydrogen-induced degradation across material classes and to identify specific mechanistic roles for hydrogen-affected deformation in promoting material damage.

In conventional austenitic stainless steels currently specified for hydrogen containment components, the mechanism for reduced ductility or higher fatigue crack growth rate in the presence of hydrogen has not been well understood. In a study led by Dr. Akihide Nagao (WPI Visiting Scholar), two commercial austenitic stainless steels with different alloy compositions were examined: 316L and 304. Non-charged (4 mass ppm of H) and hydrogen-charged (104 mass ppm of H) specimens were subjected to slow strain rate and fatigue-crack growth tests. In the slow strain rate tests, hydrogen-charged 316L does not show any reduction in ductility compared with the non-charged material, whereas 304 shows a 74% decrease in ductility in the hydrogen-charged state. A ductile dimpled morphology was observed on fracture surfaces for both non-charged and hydrogen-charged 316L. In contrast for 304, the fracture surface in the non-charged state was dominated by ductile dimples, whereas in the hydrogen-charged state it has a mixed morphology of “flat” and “quasi-cleavage” features. The mechanism for the reduction in ductility of 304 is being pursued by mainly revealing the microstructure immediately beneath the hydrogen-induced fracture surface using a FIB-TEM technique. This FIB-TEM technique was featured in previous accomplishments and represents a state-of-the-art method for evaluating a potential link between hydrogen-affected deformation and material damage.

In a complementary study led by Prof. Reiner Kirchheim (WPI PI), experiments on the effect of hydrogen on the formation of dislocations during plastic deformation of metals were conducted and interpreted in a general model of solute defect interaction. Palladium was chosen as a model face-centered cubic (FCC) material for studying the development of dislocations during slow strain rate and fatigue testing of hydrogen-exposed alloys.In this study, it was shown that during cold rolling of palladium more dislocations were produced in the presence of dissolved hydrogen when compared with hydrogen-free palladium. The increased dislocation density was determined by X-ray diffraction, transmission electron microscopy (Fig. 1.3), and using hydrogen as a probe. This experimental evidence provides compelling support for a general model on solute-defect interaction developed by Prof. Kirchheim. These results obtained for the Pd-H system suggest that the effect of hydrogen on dislocation microstructure evolution has general validity in FCC alloys, i.e., such hydrogen-dislocation interactions likely apply to the 316L and 304 stainless steels described above. It is possible that this effect of hydrogen on dislocation microstructure evolution may be linked to material damage.

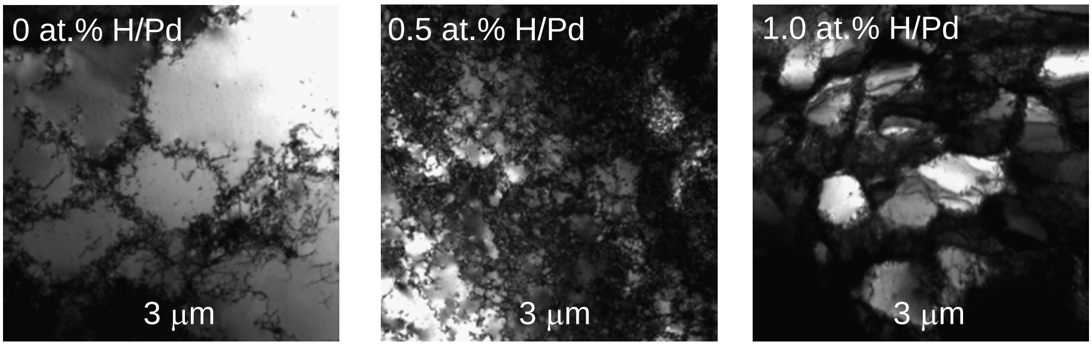


Fig. 1.3. Transmission electron microscopy (TEM) micrographs of cold-rolled palladium with various amounts of dissolved hydrogen. In H-free Pd (left) the dislocations are arranged in walls around dislocation free cells. With 0.5 at.% H significantly more dislocations have been generated and the cells become smaller (middle). With 1 at.% H the contrast between adjacent cells is pronounced due to a very high dislocation density in the walls and a corresponding misorientation between cells.

The results on hydrogen-induced dislocation formation in the Pd-H system suggest that the dislocation microstructure and hydrogen transported by mobile dislocations may play important roles in establishing the local conditions that promote failure. For example, hydrogen transport by mobile dislocations may allow excess hydrogen concentrations at the levels required for decohesion events to initiate, e.g. at grain boundaries. In a study led by Prof. Petros Sofronis (WPI PI) and Prof. Ian Robertson (WPI PI), this effect was quantified by developing a revised model for hydrogen transport that accounts for hydrogen carried by dislocations along with stress driven diffusion and trapping at other microstructural defects. This revised model represents an advancement in predicting local hydrogen concentrations, since the classical hydrogen transport model accounts for hydrostatic drift and trapping of hydrogen at defects but neglects the effect of hydrogen transport by moving dislocations. The impact of this additional transport mechanism was explored for cracked specimens under small scale yielding and plane strain conditions, assuming the material is hydrogen-exposed austenitic stainless steel, i.e., Nitronics 40. This modeling indicates that dislocation transport can contribute to elevated local hydrogen concentrations ahead of the crack tip to levels above those predicted by the classical diffusion model. This is the first step toward capturing the experimentally observed effect of hydrogen on dislocation microstructure evolution in a predictive model for hydrogen-induced material degradation. Such models must accurately quantify the hydrogen populations ahead of a crack tip to inform the failure criterion.

<u>Publications</u>

K.E. Nygren, A. Nagao, M. Dadfarnia, P. Sofronis, I.M. Robertson, Effect of hydrogen on fatigue-crack growth behavior of types 316L and 304 austenitic stainless steels, CAMP-ISIJ, vol. 28, p. 301, 2015.
M. Deutges, H.P. Barth, Y. Chen, C. Borchers, R. Kirchheim, Hydrogen diffusivities as a measure of relative dislocation densities in palladium and increase of the density by plastic deformation in the presence of dissolved hydrogen, Acta Materialia, vol. 82, pp. 266–274, 2015.
R. Kirchheim, A. Pundt, Hydrogen in Metals. In: D.E. Laughlin, K. Hono (Eds.), Physical Metallurgy, pp. 2597–2705, 2014.
Y.Z. Chen, X.Y. Ma, X.H. Shi, T. Suo, C. Borchers, K.H. Zhang, F. Liu, R. Kirchheim, Hardening effects in plastically deformed Pd with the addition of H, Scripta Materialia, vol. 98, pp. 48-51, 2015.
M. Dadfarnia, M.L. Martin, A. Nagao, P. Sofronis, I.M. Robertson, Modeling hydrogen transport by dislocations, Journal of the Mechanics and Physics of Solids, 2015, in press. (DOI: 10.1016/j.jmps.2015.03.002).

Ultra-fine grained materials for hydrogen compatibility: technology impact.

The scientific achievements described below represent progress toward the milestones of develop hydrogen-compatible, lower-cost austenitic stainless steels having 400 MPa yield strength and quantify fatigue limit in hydrogen gas for austenitic stainless steel with 400 MPa yield strength. These short-term milestones are featured in the division's Project 2: High-Strength, Low-Cost Stainless Steels for H_2 Service.

Prof. Setsuo Takaki (WPI PI) has pioneered the process of ultra-grain refinement in austenitic stainless steels. Such grain refinement significantly increases the strength of austenitic steels while retaining acceptable ductility. Based on physical descriptions of hydrogen-materials interactions reported in the literature (i.e., studies related to Project 1), it was expected that ultra-grain refinement of austenitic steels could also improve resistance to hydrogen-induced degradation. Previous research results in Project 2 confirmed this trend from slow strain rate testing of hydrogen-exposed ultra-fine grained (UFG) stainless steels. As demonstrated from the stress vs. strain curves in Fig. 1.4, the tensile ductility of the metastable Fe-16Cr-10Ni austenitic stainless steel with grain sizes of 1µm and 6µm is not degraded by hydrogen (24.5 mass ppm concentration). Since the UFG steel with 1µm grain size has a yield strength of 585 MPa, these results represent progress toward the short-term milestone of developing a hydrogen-compatible austenitic stainless steel having 400 MPa yield strength. However, evaluating hydrogen compatibility with slow strain rate testing was not sufficient. Satisfying the hydrogen compatibility aspect of the milestone requires fatigue testing on hydrogen-exposed stainless steels. Results from fatigue testing are more relevant for establishing hydrogen compatibility of structural materials for hydrogen fuel technology applications.

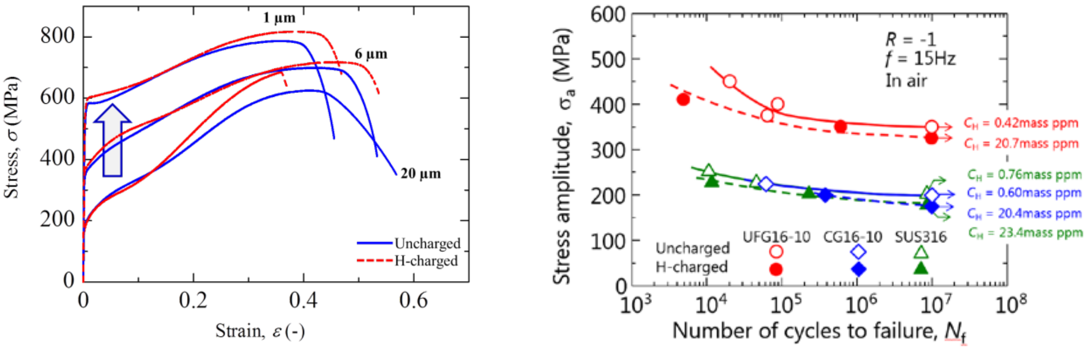


Fig. 1.4. The stress vs. strain curves measured for Fe-16Cr-10Ni stainless steel show that hydrogen does not degrade tensile ductility for materials with 1µm and 6µm grain sizes (left). The stress amplitude vs. cycles to failure relationships measured for Fe-16Cr-10Ni stainless steel with 1µm grain size (UFG16-10) and 20µm grain size (CG16-10) demonstrate that the UFG material has a higher fatigue limit that is not degraded by hydrogen (right).

The need for technology-relevant hydrogen compatibility data was addressed by performing fatigue tests on the hydrogen-exposed UFG stainless steel. As shown in Fig. 1.4, the number of cycles to failure was measured for several stainless steels as a function of the cyclic stress amplitude. These stainless steels included the UFG material, a coarse-grained (CG) material with the same alloy composition, and a commercial stainless steel (SUS316). The stress amplitude vs. cycles to failure relationship was determined for the stainless steels in the hydrogen-charged (20 to 23 mass ppm concentration) and non-charged conditions. Two notable results are revealed from the data in Figure 1.4. First, the fatigue limit (e.g., stress amplitude at 10^7 cycles) is significantly higher for the UFG material compared to the CG and commercial stainless steels. In addition, this relatively high fatigue limit is not degraded by hydrogen. This result demonstrates that hydrogen containment components designed according to the fatigue limit can be fabricated with UFG stainless steel and be considered as hydrogen compatible.
The results presented above represent a significant advancement toward the collective milestones of develop hydrogen-compatible, lower-cost austenitic stainless steels having 400 MPa yield strength and quantify fatigue limit in hydrogen gas for austenitic stainless steel with 400 MPa yield strength. The remaining effort to complete this milestone may be to measure the fatigue limit of the UFG stainless steel with higher hydrogen concentrations. The UFG stainless steel could tangibly benefit hydrogen fuel technology by reducing the cost of components without compromising hydrogen compatibility. By applying the UFG material processing, high-strength type 304 stainless steel could replace low-strength type 316 stainless steel in hydrogen fuel systems, which would significantly decrease system cost while retaining resistance to hydrogen-induced degradation.

<u>Publications</u>

A. Macadre, K. Tsuboi, N. Nakada, T. Tsuchiyama, S. Takaki, Ultra-grain refinement effect on tensile and phase transformation behaviour in a metastable austenitic steel charged in hydrogen gas, Procedia Materials Science, vol. 3, pp. 350-356, 2014.
K. Mori, M. Kubota, A. Macadre, Fatigue properties of ultra-fine grain austenitic stainless steel and effect of hydrogen, Proceedings of the third Japan-China Joint Symposium on Fatigue of Engineering Materials and Structures, Takayama, Japan, pp. 82-85, 2014.

Fuel Cells (Lead Principal Investigator: Prof. Sasaki)

The objective of this division is to develop more durable and efficient, lower cost fuel cells, such as polymer electrolyte fuel cells (PEFCs) and solid oxide fuel cells (SOFCs). In PEFCs, efforts are directed at a) the development of higher temperature (> 100°C) hydrogen PEM fuel cells with durable catalyst support, b) finding and evaluating high temperature electrolytes with emphasis on a polybenzimidazole (PBI)-based ionomer in combination with carbon nanotubes, including additional materials, such as graphene. In SOFCs, efforts are directed at exploring degradation mechanisms of pressurized SOFCs and understanding fundamental surface/interfacial catalytic processes on metal oxides for fuel-flexible stationary and power-plant applications, especially the Integrated Gasification Fuel Cell Combined Cycle (IGFC) and the Natural Gas Triple Combined Cycle. Selected representative results are:

Chemo-Mechanics of Fuel Cell Oxides

One goal of the fuel cell division is to enhance the durability of solid oxide fuel cells with a target of 90,000 h stable operation. Currently, the operating lifetime is limited, in part, by thermo-chemical expansion-induced stresses within the brittle oxide components (Fig. 1.5), exceeding their strength and leading to mechanical failure, such as cracking and delamination of the electrolyte and electrodes. Chemical expansion is one causative process, whereby the oxides expand in an amount proportional to the loss of oxygen from their lattice; the proportionality is described by the chemical expansion coefficient. In order to minimize these strains and thereby enhance durability, it is necessary to understand the chemical expansion process at a fundamental level so that materials with low chemical expansion coefficients can be rationally designed.

Therefore, in our work we combine both *in situ* macroscopic and crystal-level experimental studies with atomistic computational simulations of model systems, to investigate the chemical expansion of fuel cell oxides in detail. Building on the work of previous years, in FY2014 this approach led to several key achievements: 1) In response to the emergence of this new field of chemo-mechanics of oxides, we published an invited review paper in collaboration with experts around the world defining chemical expansion and its implications for energy conversion devices; 2) We identified four key factors impacting chemical expansion in the technologically important perovskite structure – charge localization, crystal symmetry, temperature, and oxygen vacancy size – leading to development of design principles for low chemical expansion coefficients in perovskites; and 3) We developed a comprehensive empirical model that relates perovskite chemical expansion to the size of the constituent ions, enabling determination of the effective size of an oxygen vacancy in a variety of perovskite oxides, a key parameter controlling chemical expansion.

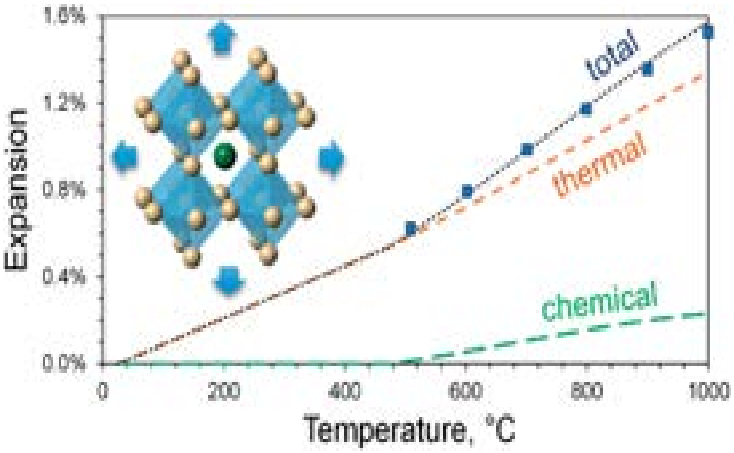


Fig. 1. 5. Relative contributions of thermal and chemical processes to the expansion of a perovskite. *J. Mater. Chem. A* 3, 3602-3611, (2015)

These achievements are expected to have widespread impact. First, our review paper increases awareness of the significance of chemo-mechanical coupling in energy devices and describes tools to investigate it to a wide audience, potentially leading to a broader international effort to design durable energy device materials. Second, we have demonstrated for the first time, by theory and experiment, certain controllable variables that correlate to smaller chemical expansion coefficients (and therefore greater durability) of perovskites. These variables provide a novel path forward to design durable oxides for next-generation solid oxide fuel cells, solid oxide electrolysis cells, gas separation membranes, and high temperature sensors, with long lifetimes.

This work is a significant accomplishment toward the long term durability milestone against all major degradation mechanisms, especially impurity poisoning of SOFCs, in Project 2 in the Division's Roadmap.

Publications

S.R. Bishop, D. Marrocchelli, C. Chatzichristodoulou, M. Mogensen, N.H. Perry, H.L. Tuller, E.D. Wachsman (Invited review), Chemical Expansion: Implications for Electrochemical Energy Storage and Conversion Devices, Annual Review of Materials Research, vol. 44, pp. 205-239, 2014.

N.H. Perry, S.R. Bishop, H.L. Tuller, Tailoring Chemical Expansion by Controlling Charge Localization: In Situ X-ray Diffraction and Dilatometric Study of $(La,Sr)(Ga,Ni)O_{3-\delta}$ Perovskite, Journal of Materials Chemistry A, vol. 2, pp. 18906-18916, 2014.

N.H. Perry, J.J. Kim, S.R. Bishop, H.L. Tuller, Strongly Coupled Thermal and Chemical Expansion in the Perovskite Oxide System $Sr(Ti,Fe)O_{3-\alpha}$, Journal of Materials Chemistry A, vol. 3, pp. 3602-3611, 2015.

D. Marrocchelli, N.H. Perry, S.R. Bishop, Understanding Chemical Expansion in Perovskite-Structured Oxides, Physical Chemistry Chemical Physics, vol. 17, pp. 10028-10039, 2015.

Metal-free Electrocatalysts for the Oxygen Reduction Reaction

Pt/Co/C is the state-of-the-art catalyst for the oxygen reduction reaction (ORR) in PEFCs. However this material is expensive and degrades during potential cycling. Fe/N/C-based catalysts are the most promising alternative ORR catalysts to date, but their durability is still problematic due to significant H_2O_2 production and the presence of Fe which leaches during operation. Fundamental understanding of these electrocatalysts is necessary to make further improvements.

We take a unique approach of studying *metal-free* nitrogen-doped graphene as a model electrocatalyst system. Previous studies generally struggle to remove the influence of Fe contamination. We observe high current densities for the ORR in acid, with some 4-electron transfer contribution. *This challenges the current paradigm that Fe-free sites only catalyze 2-electron ORR.* We show that metal-free tertiary N sites may catalyze the 4-electron ORR in acid. Additionally we have demonstrated remarkable durability of this catalyst, far out-performing Pt over 60,000 potential cycles in alkaline solution.

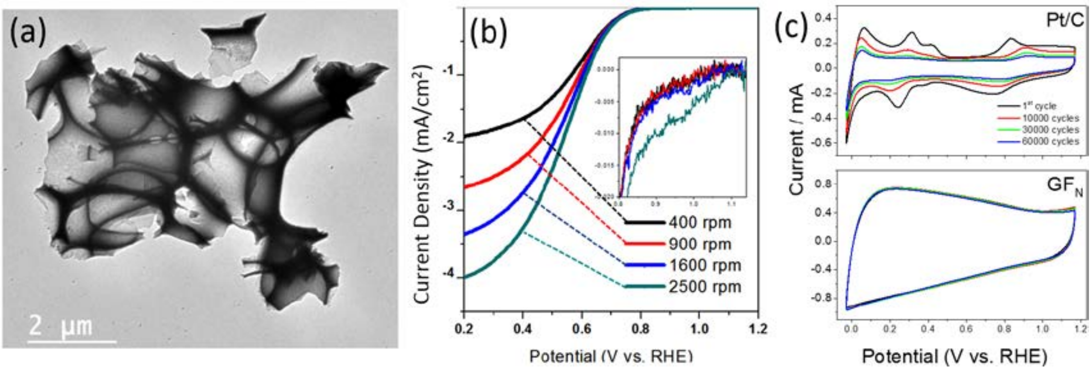


Fig. 1. 6. (a) TEM of nitrogen-doped graphene foam. (b) ORR current density in acid solution. (c) Comparison of the durability of Pt/C and nitrogen-doped graphene foam in alkaline solution, over 60,000 cycles (FCCJ protocol).

This work is a major accomplishment against the short term milestone to meet NEDO/FCCJ & DOE durability targets and the ultimate target of achieving durability for longer than 15 years in Project 1 in the division roadmap.

Publications

J. Liu, T. Daio, D. Orejon, K. Sasaki, S.M. Lyth, Defective Nitrogen-Doped Graphene Foam: A Metal-Free, Non-Precious Electrocatalyst for the Oxygen Reduction Reaction in Acid, Journal of the Electrochemical Society, vol. 161, iss. 4, pp. F544-F550, 2014.

J. Liu, T. Daio, B. Cunning, K. Sasaki, S.M. Lyth, Nitrogen-Doped Graphene Foam as a Highly Durable Metal-Free Electrocatalyst for the Oxygen Reduction Reaction in Alkaline Solution, Journal of Materials Chemistry A (Under Revision, 2015).

Thermal Science and Engineering (Lead Principal Investigator: Prof. Takata)

The objective of this division is to enable the most effective use of materials in carbon-neutral energy technologies and to improve the energy efficiency of thermal processes by expanding our knowledge of material thermophysical properties and thermal science and engineering. More specifically, research in the division aims at: expanding our knowledge-base of thermophysical properties of hydrogen and alternative refrigerants to enable their most efficient use to reduce CO_2 emissions; improving our understanding of the basic science of heat and mass transfer to enable the development of more efficient energy systems; and researching new thermal energy heat pump and refrigeration systems focused on the use of waste heat and new refrigerants for improved overall energy efficiency and reduced CO_2 emissions.   Selected representative results are:

Near-vacuum generation by hydrogen permeation

Hydrogen permeation through metals and alloys is of great concern in hydrogen containment systems. In this study, hydrogen contained in seamless coiled tube vessels made of SUS316L and Inconel 625 permeated the vessel walls at temperatures from 573 K to 773 K, and the decreasing interior pressure of the vessels was monitored for an extended period of time to characterize the behavior of the pressure change. It was found that the pressure in the vessels became lower than the surrounding atmospheric pressure, and the vessels reached nearly vacuum conditions, (exactly, the partial pressure of impurities). Hydrogen permeabilities through SUS316L and Inconel 625 were determined from the pressure drop measurements. The pressure drop behavior was compared to, and found to be consistent with, theoretical calculations performed using the obtained permeabilities based on Fick's law of diffusion.

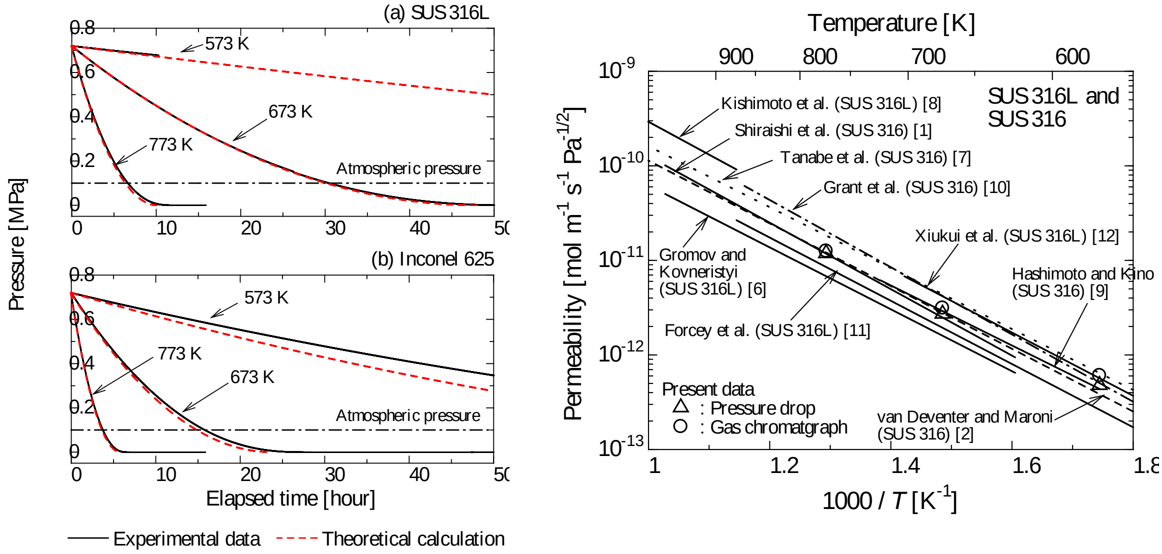


Fig. 1. 7. (Left) Pressure drop due to permeation of hydrogen in seamless coiled tube vessels made of (a) SUS316L and (b) Inconel 625. (Right) Temperature dependence of the hydrogen permeability through SUS316L and SUS316. References quoted inside brackets are from the references section of the publication below.

This work satisfies the short term milestone of the establishment of a prediction method for hydrogen permeation through a metal wall in Thermophysical Properties Project 1 (TP-1) in the division roadmap.

Publication:

N. Sakoda, R. Kumagai, R. Ishida, K. Shinzato, M. Kohno, Y. Takata, Vacuum generation by hydrogen permeation to atmosphere through austenitic and nickel-basealloy vessel walls at temperatures from 573 K to 773 K, International Journal of Hydrogen Energy, vol. 39, pp. 11316-11320, 2014.

Adsorbents for next generation cooling systems

Adsorption characteristics of ethanol onto two promising adsorbents have been investigated for developing high performance adsorption chillers. These new adsorbents are based on spherical phenol resin treated with different mass ratios of KOH named as KOH4-PR and KOH6-PR. Experimental adsorption isotherm measurements show that the adsorption capacity of KOH4-PR/ethanol is as high as 1.43 kg kg^{-1} while one kg of KOH6-PR is able to adsorb nearly about 2 kg of ethanol. To the best of our knowledge, the studied adsorbents possess the highest ethanol uptake. Moreover, we found that the KOH4-PR/ethanol pair has notably high adsorption kinetics at the lower range of adsorption temperatures. Experimental measurements of adsorption uptake and adsorption uptake rate of the studied pairs have been analyzed and isosteric heats of adsorption have also been extracted.

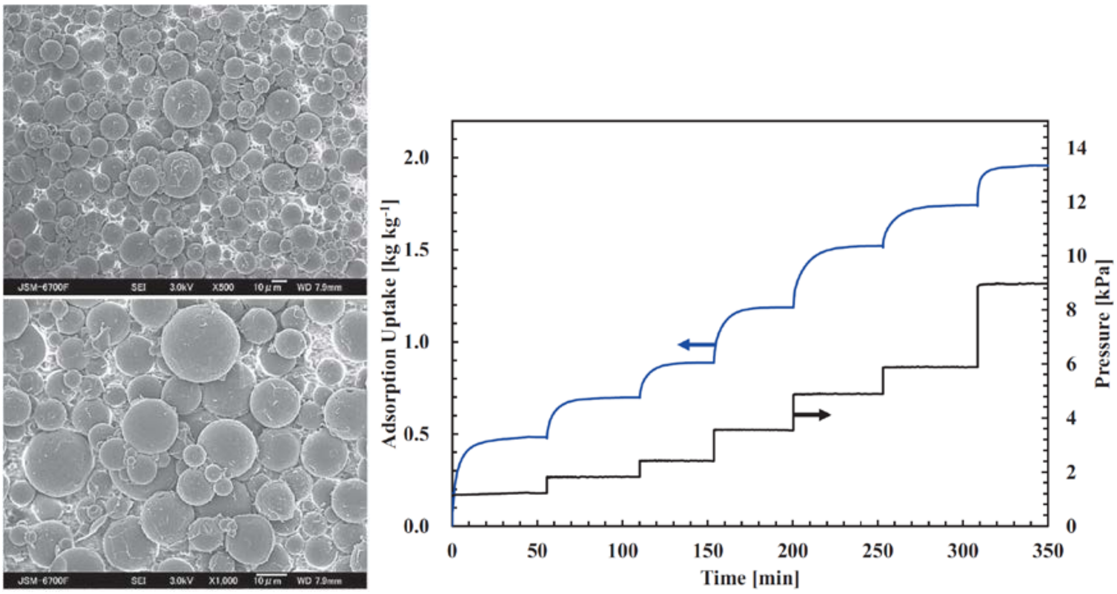


Fig. 1.8. (Left) SEM pictures of KOH4-PR adsorbent samples. (Right) Profiles of adsorption uptake and pressure for KOH6-PR/ethanol pair at adsorption temperature 30°C.

This work satisfies the short- and mid-term milestones of developing a clear understanding of adsorption/desorption processes of activated carbon in HMT Project 2 in the division roadmap.

Publication:

I.I. El-Sharkawy, K. Uddin, T. Miyazaki, B.B. Saha, S. Koyama, H.-S. Kil, S.-H. Yoon, J. Miyawaki, Adsorption of ethanol onto phenol resin based adsorbents for developing next generation cooling systems, International Journal of Heat and Mass Transfer, vol. 81, pp. 171–178, 2015.

Hydrogen Storage (Lead Principal Investigator: Prof. Akiba)

The research in the division aims at developing new carrier materials for hydrogen mobile and stationary storage, as well as for hydrogen delivery. For mobile hydrogen storage, the material based storage system must meet the needs of hydrogen fuel cell vehicles in terms of volume, weight percent hydrogen, cost, fast charging and discharging, and durability with high well-to-wheel energy efficiency. Hydrogen delivery systems based on hydrogen-absorbing materials are focused on cost effective truck transport of large amounts of hydrogen. Material based stationary hydrogen storage applications must be more cost effective and energy efficient than conventional pressurized gaseous hydrogen storage or uniquely meet particular requirements of specific stationary applications. Selected representative results are:

Influence of grain boundaries on activation of TiFe

TiFe samples were processed by four different routes (annealing, groove rolling, high-pressure torsion (HPT) and ball milling) to produce different microstructural features. It was found that there is a strong relationship between the grain size (fraction of grain boundaries) and activation pressure for hydrogen absorption: the hydrogen pressure for activation decreases with decreasing grain size as shown in Fig. 1.9.

The generation of grain boundaries (as well as stacking faults) also appears to be effective for activation of other hydrogen storage materials such as Mg_2Ni.

This study provides important finding for the milestone of “Start commercialization of HPT-processed TiFe for stationary application and HPT-processed Mg alloys for on board application ” in the Project 3 of the Division.

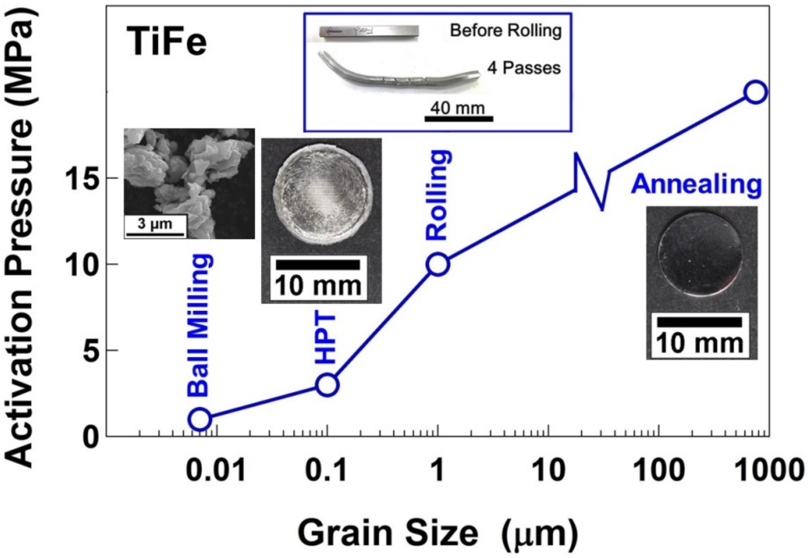


Fig. 1.9. Decreasing activation pressure of TiFe by decreasing grain size.

Publications

K. Edalati, J. Matsuda, A. Yanagida, E. Akiba, Z. Horita, Activation of TiFe for hydrogen storage by plastic deformation using groove rolling and high-pressure torsion: Similarities and differences, International Journal of Hydrogen Energy, vol. 39, pp. 15589-15594, 2014.

H. Emami, K. Edalati, J. Matsuda, E. Akiba, Z. Horita, Hydrogen storage performance of TiFe after processing by ball milling, Acta Materialia, vol. 88, pp. 190-195, 2015.

T. Hongo, K. Edalati, M. Arita, J. Matsuda, E. Akiba, Z. Horita, Significance of grain boundaries and stacking faults on hydrogen storage properties of Mg_2Ni intermetallics processed by high-pressure torsion, Acta Materialia, vol. 92, pp. 46-54, 2015.

Complex hydride $LiBH_4$ as a lightweight hydrogen storage material

The complex hydride $LiBH_4$, with a hydrogen density of 18.5 mass%, has been attracting significant interest as a lightweight hydrogen storage material. However, it has a high dehydrogenation and rehydrogenation temperature because of the formation of $Li_2B_{12}H_{12}$ as a dehydrogenated intermediate. Introduction of Ni is expected to reduce the dehydrogenation enthalpy, and suppress the formation of $Li_2B_{12}H_{12}$ by nickel boride like Ni_4B_3, Ni_2B or Ni_3B.

In this study, we systematically investigated the effect of nanosized Ni on the dehydrogenation and rehydrogenation reactions of $LiBH_4$ using thermogravimetry, quadrupole mass spectrometry and pressure-composition-isotherm analyses. Nanosized Ni particles were homogeneously dispersed on the surface of $LiBH_4$ after ball milling. The dehydrogenation peak temperature of $LiBH_4$ was reduced from 743 K to 696 K with addition of 25 mass% Ni. First, $LiBH_4$ tended to react with Ni to form Ni_4B_3, which suggests the thermodynamic destabilization effect of Ni. Then, the in-situ formed Ni_4B_3 was suggested to play a catalytic role on the dehydrogenation of the unreacted $LiBH_4$. Moreover, the rehydrogenation content of $LiBH_4$ was improved from 4.3 mass% to 10.8 mass% by addition of 25 mass% Ni, suggesting the significant improvement effect of Ni_4B_3 on the rehydrogenation.

This study provides important finding for the milestone of “Define relationship between formation of intermediates and de-/re-hydrogenation of borohydrides” in the Project 2 of the Division.

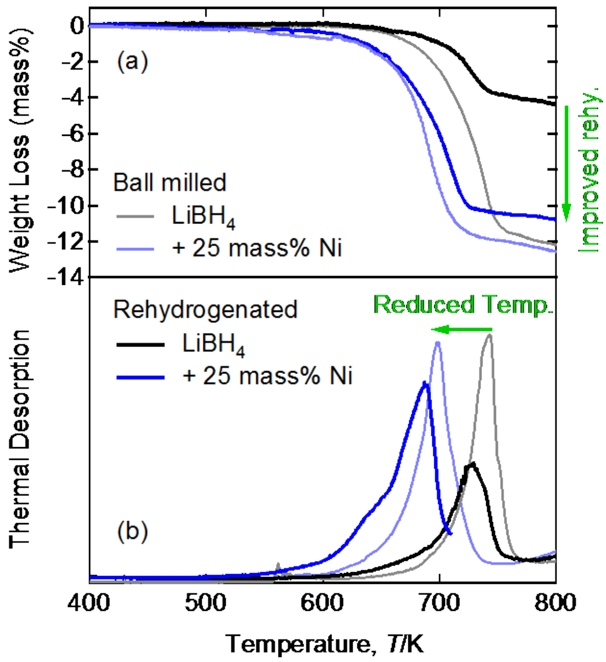


Fig. 1.10 (a) Thermogravimetry (TG) and (b) quadrupole mass spectrometer (QMS) measurement results of ball milled $LiBH_4$ and $LiBH_4$—Ni as well as the samples after rehydrogenation under a hydrogen pressure of 35.0 MPa at 823 K for 24 h.

<u>Publications</u>

H.-W. Li, Y. Yan, E. Akiba, S.-i. Orimo, Improved Dehydrogenation and Rehydrogenation Properties of $LiBH_4$ by Nanosized Ni Addition, Materials Transactions, vol. 55, pp. 1134-1137, 2014.

Catalytic Materials Transformations (Lead Principal Investigator: Prof. Ogo)

The objective of this division is to contribute to the creation of innovative carbon-neutral technologies by developing “Novel Catalysts,” underlining both aspects of basic science and engineering. The activities are focused on investigating catalysis-related “Solar Energy and Energy Conservation,” all of which have the potential to significantly increase energy efficiency and reduce CO_2 emissions in energy, power, or industrial production processes. Projects in the division address the development of: (i) novel biological and biomimetic catalysts for H_2, CO_2, and H_2O activation based on naturally occurring enzymes; (ii) materials development toward the realization of a carbon-neutral power generation cycle. Selected representative results based on biology’s ways with hydrogen are:

[NiFe]Hydrogenase from Citrobacter sp. S-77 Surpasses Platinum as an Electrode for H_2 Oxidation Reaction.

In a paper that combines biochemistry, bioinorganic chemistry, and electrochemistry, we reported an electrode for H_2 oxidation, based on [NiFe]Hydrogenase from our isolated new bacterium *Citrobacter* sp. S-77, that has 637 times higher mass activity than platinum at 50 mV in a hydrogen half-cell. The hydrogenase electrode is also stable in air and, unlike Pt, can be recovered 100% after poisoning by carbon monoxide. Following characterization of the [NiFe]Hydrogenase electrode, we demonstrate the construction of a fuel cell comprising [NiFe]Hydrogenase anode and Pt cathode with a higher power density than that achievable by Pt.

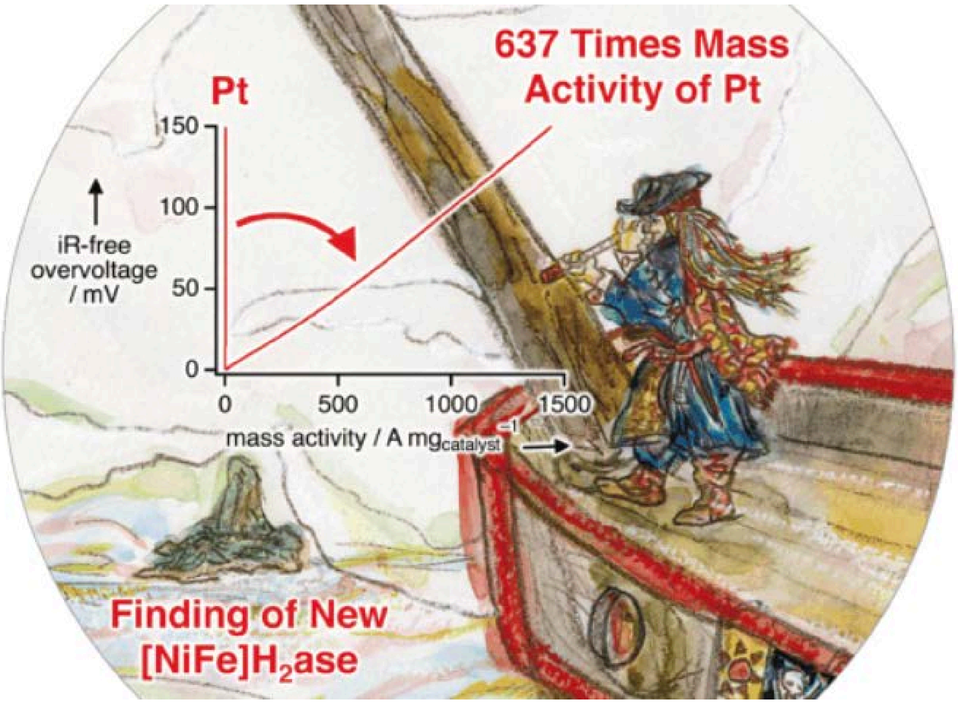


Fig. 1.11 Image of finding of H_2ase S–77. Selected for the cover picture of *Angewandte Chemie International Edition* (ACIE)

Together with the previous studies of biomimetic [NiFe]hydrogenase published in Science 2013, we have satisfactorily realized the short-term milestone on "H_2-activation: Isolation of new hydrogenase and its model complex" in the division's roadmap for Project 1. In fact this is the best result achieved worldwide (Prof. Ogo's benchmark).

Publication

T. Matsumoto, S. Eguchi, H. Nakai, T. Hibino, K.S. Yoon, S. Ogo, [NiFe]Hydrogenase from Citrobacter sp. S-77 Surpasses Platinum as an Electrode for H_2 Oxidation Reaction, Angew. Chem. Int. Ed., vol. 53, iss. 34, pp. 8895–8898, 2014.

[Cover Picture] [Press Release] [NHK and RKB Mainichi Broadcasting Corporation] [NHK Radio] [Nikkankogyo Shimbun, Nikkei Shimbun, Nishinippon Shimbun, Mainichi Shimbun, Sankei Shimbunand Yomiuri Shimbun] [Wiley Science Cafe] [Science Portal]

CO_2-Free Power Generation on an Iron Group Nanoalloy Catalyst via Selective Oxidation of Ethylene Glycol to Oxalic Acid in Alkaline Media

We are developing catalysts which enable electric power generation without CO_2 emission by selective oxidations of fuels as a target in the first period of our road map. In this year, we succeeded in the preparation of nanoalloy (NA) catalysts composed of iron-group elements. An Fe group ternary nanoalloy catalyst exhibits selective electrocatalysis towards CO_2-free power generation from highly deliverable ethylene glycol (EG). We examined the distribution of oxidised species, including CO_2, produced on the FeCoNi nanoalloy catalyst in the EG electrooxidation under alkaline conditions. The FeCoNi nanoalloy catalyst showed the highest selectivities toward the formation of C_2 products and to oxalic acid, i.e., 99 and 60%, respectively, at 0.4 V vs. the reversible hydrogen electrode (RHE), without CO_2 generation. We successfully generated power by a direct EG alkaline fuel cell employing the FeCoNi nanoalloy catalyst and a solid-oxide electrolyte with oxygen reduction ability, i.e., a completely precious-metal-free system.

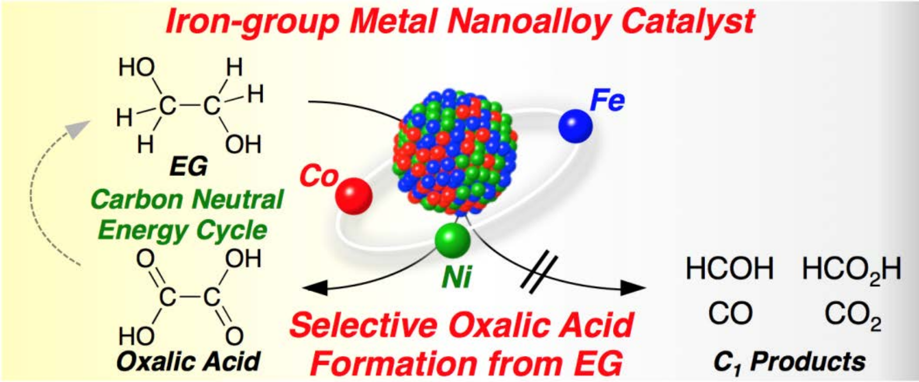


Fig. 1.12. CO_2-free power generation by selective fuel oxidation with iron-group nanoalloy catalysts.

This work is related to the short-term milestone "Non-platinum catalysts: 50 mW·cm^{-1}" of Project 3 "development toward carbon-neutral power generation cycles" in the division's roadmap and it is the first report of completely precious-metal-free alkaline fuel cells.

Publication

T. Matsumoto, M. Sadakiyo, M. L. Ooi, S. Kitano, T. Yamamoto, S. Matsumura, K. Kato, T. Takeguchi, M. Yamauchi, CO_2-free power generation on an iron group nanoalloy catalyst via selective oxidation of ethylene glycol to oxalic acid in alkaline media, Scientific Reports, vol. 4, no. 5620, 2014.

CO_2 Capture and Utilization (Lead Principal Investigator: Prof. Fujikawa)

The objective of this division is to develop: (1) highly efficient materials for CO_2 separation in power generation and industrial processes; and (2) electrochemical methods to convert CO_2 into value-added chemicals, such as a liquid fuels or their intermediates, in an energy-efficient and cost-effective way. *In the area of CO_2 separation*, the objective is to develop novel membrane technology to separate CO_2 in the process of pre-combustion for Integrated Coal Gasification Combined Cycle (IGCC), post-combustion at power plants and other industries, and for gas purification at natural gas wells. Membrane separation presents serious scientific challenges. Conventional membrane technologies are limited by low gas permeability, although their CO_2 selectivity is now reaching acceptable levels for application. The most promising approach to improve gas permeability is membrane thinning, because current membranes are still several microns thick. Thus, research in this division focuses on the design and development of materials for thinner membranes for selective gas separation. *In the area of electrochemical CO_2 conversion*, the objective is to develop better catalysts and electrodes. Most current catalysts require a high over-potential to drive electrochemical reduction of CO_2. Thus, the focus of the division is to develop catalysts that reduce this overpotential, thereby increasing the energetic efficiency of the process, while at the same time creating electrodes that eliminate mass-transport limitations in the electrolyzer cells. Selected representative results are:

Improving anode catalyst for the efficient electrochemical conversion of CO_2 to CO

In this project, we have achieved the highest current density for electroreduction of CO_2 to CO reported to date under ambient conditions through the optimization of anode catalysts. Recently, significant efforts have focused on the exploration of new cathode catalysts since the present high overpotential and low conversion rates on cathode catalysts prevent this process from being further developed for commercialization, however, considerably fewer efforts have studied how improvement the anode affects overall cell performance. Apart from our extensive research on the cathode catalyst, we believed that the optimization on the anode catalyst would improve the whole system performance significantly. In one of the projects we have accomplished this year, we showed that in combination with high performance Ag cathodes and 1 M KOH electrolyte, the use of IrO_2 instead of Pt black (a widely used anode catalyst in CO_2 reduction applications) as the anode catalyst lowered ~0.2 V onset potential to 1.6 V, and achieved the highest partial current densities for CO (250 mA cm^{-2}, Fig. 1.13) reported to date under ambient conditions, compared to 130 mA cm^{-2} when Pt black was used as the anode catalyst. Also, the use of IrO_2 anodes led to energy efficiencies as high as 70% (Fig. 1.14), which is about 40% improvement compared to the case using Pt as the anode catalyst. This work demonstrates that we have already reached the benchmark (Faradaic efficiency: 80~85%, energy efficiency: >70%, current density: 250 mA cm^{-2}) in our Division's roadmap for CO production. Although highest energy efficiency and highest current density are not achieved at the same time, we believe that this finding, in combination with further development on the cathode catalyst, will finally help us produce high amount of CO at energy efficiency above 70%. This work is related to Project 2

"Electrochemical conversion" in the division's roadmap and addresses the closely related short-term milestones of "Catalysts for efficient CO_2 conversion" and "Optimize faradaic efficiency, current density, energetic efficiency". In fact this performance meets the division's CO production benchmark of "Faradaic Efficiency: 80~85%; Energy Efficiency: >70%; Current Density: 250 mA cm^{-2}."

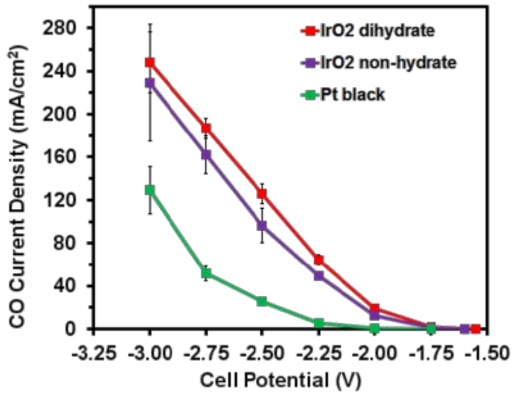


Fig. 1.13. Partial current densities for CO relative to the cathode potential.

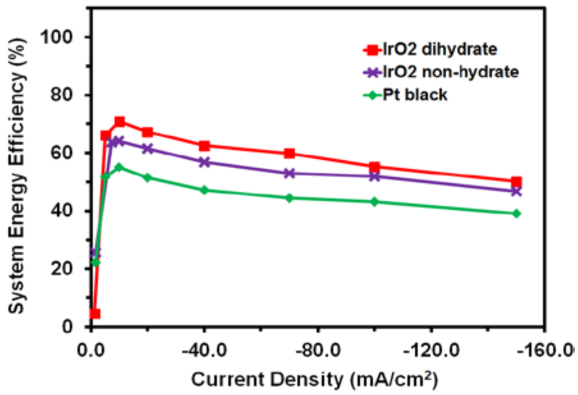


Fig. 1.14. System energy efficiency relative to the total current density.

<u>Publication</u>

S. Ma, R. Luo, S. Moniri, Y. Lan, P.J.A. Kenis, Efficient Electrochemical Flow System with Improved Anode for the Conversion of CO_2 to CO, Journal of the Electrochemical Society, vol. 161, iss. 10, pp. F1124-F1131, 2014.

CO_2 Storage (Lead Principal Investigator: Prof. Tsuji)

The objective of this division is to: develop methods of reservoir characterization and modeling, and new effective monitoring of injected/leaked CO_2 to help ensure safe and permanent CO_2 sequestration in sub-seabed geologic formations; and propose and realize new carbon storage concepts suitable for geological formations and rock types typical of Japan. The research projects and efforts have been established in such a way that they take into consideration the heterogeneity of the geological formations in Japan, the limited availability of geological data for CO_2 injection in aquifer formations, and the requirement for long term monitoring of pressure variations near seismogenic faults. Selected representative results include:

Identify reservoir conditions for effective and safe CO_2 storage (pore-scale investigation)

To quantify capillary trapping mechanisms and access suitable reservoir conditions for efficient and safe CO_2 storage, we characterized CO_2 cluster within rock pore under different interfacial tension (IFT) conditions mainly using the lattice Boltzmann method (LBM) (see Fig. 1.14 (a)). Here we injected water into the CO_2-saturated rock to evaluate capillary CO_2 trapping. A force balance factor N between capillary and viscous force is proposed to evaluate the instability of trapped CO_2 (Fig. 1.14 (b)). An increase of the instability factor N indicates that the capillary force becomes unable to balance the viscous pressure drop, and the shear force starts contributing to the face balance state. We found that the N increases with the size of CO_2 cluster, indicating larger CO_2 cluster is unstable and should be easier to remobilize (Fig. 1.14 (c)). We further demonstrated that N decreases at the condition of higher interfacial tension, Fig. 1.14 (c). Therefore, high interfacial tension conditions increase residual saturation (Fig. 1.14 (d)) and improve the both capacity and stability of residual trapping storage.

Complementary experiments porous micromodel experiments at reservoir conditions wherein water was displaced by liquid CO_2 revealed the dynamics of CO_2 fingering in porous media relevant to geologic CO_2 storage. In particular, finger penetration into the porous matrix was found to occur over very short, intermittent time scales at velocities orders larger than the injection velocity. Using the microscopic particle image velocimetry (micro-PIV) technique, these are the first measurements of this kind to quantify these flow dynamics and indicate that inertial forces may be an important aspect of the force balance at the pore scale, together with capillary and viscous forces (Fig. 1.15). By understanding the transient nature of CO_2 displacement of water, optimal conditions for effective and safe storage of CO_2 can be identified.

The accomplishment represents a transformation in our understanding of pore-scale flow processes, particularly those not captured in pore-scale models currently used in reservoir characterization, and contributes to the short-term milestone (Model injected CO_2 behavior (residual, solubility and mineral trapping) from laboratory expt. & simulation) of the Division's Project 1-1 (Pore-scale investigation of CO_2 fate).

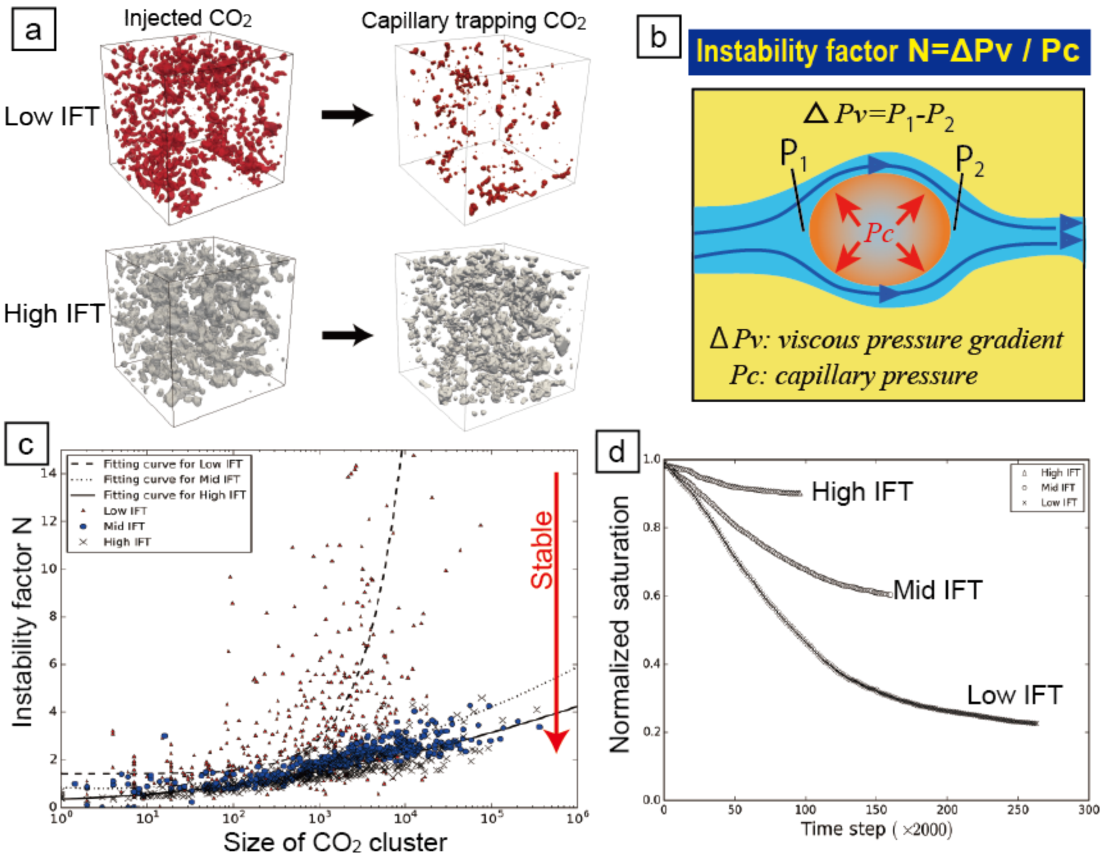


Fig. 1.14 (a) Injected CO_2 cluster (left) and capillary trapping CO_2 (right) simulated via LBM. (b) Schematic image of pore body and throat, and definition of instability factor. Blue region indicates pore space. (c) Instability factor N parameterized by size of CO_2 cluster and interfacial tension (IFT). (d) Normalized CO_2 saturation decreases due to water injection, but at the higher IFT conditions CO_2 is effectively trapped.

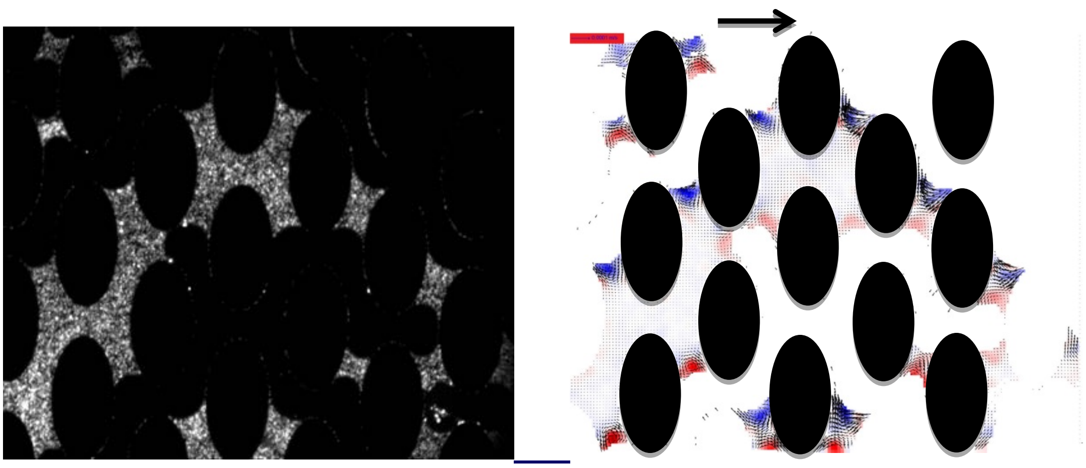


Fig. 1.15. (Left) Image showing liquid CO_2 infiltration (dark regions) from left to right at 80 bar into a water-saturated, periodic porous micromodel (porous pillars are dark ellipses). Water is seeded with fluorescent particles and this fluorescence is readily apparent above. (Right) Instantaneous velocity field in the water phase owing to liquid CO2 infiltration (white regions) from left to right at 80 bar into a water-saturated, periodic porous micromodel (porous pillars are dark ellipses). Vectors represent water velocity and contour represent vorticity (red: counter clockwise; blue: clockwise).

Publications

G. Blois, J.M. Barros, K.T. Christensen, A Microscopic Particle Image Velocimetry Method for Studying the Dynamics of Immiscible Liquid-Liquid Interactions in a Porous Micromodel, Microfluidics and Nanofluidics, vol. 18, pp. 1391-1406, 2015.

F. Jiang, T. Tsuji, Impact of interfacial tension on residual CO_2 clusters in porous sandstone, Water

Resources Research, vol. 51, iss. 3, pp. 1710-1722, 2015.
F. Kazemifar, G. Blois, D.C. Kyritsis, K.T. Christensen, A Methodology for Velocity Field Measurement in Multiphase High-Pressure Flow of CO_2 and Water in Micromodels, Water Resources Research, 2015, (DOI: 10.1002/2014WR016787)
F. Kazemifar, G. Blois, D.C. Kyritsis, K.T. Christensen, Quantifying the Flow Dynamics of Supercritical CO_2–Water Displacement in a 2D Porous Micro-Model using Fluorescent Microscopy and Microscopic PIV, Advances in Water Resources, 2015 (in revision).

Detection of localized heterogeneity in geological formation of the Tomakomai CO_2 capture and storage (CCS) site

We developed an advanced method using surface waves to estimate the 3D S-wave velocity (i.e. shear modulus) and the attenuation coefficient of geological formations. Using this method, we detected localized heterogeneity in the shallow geological formations in the Tomakomai CCS project site, which is the first large-scale CCS project in Japan. We successfully estimated a 3D S-wave velocity model (Fig. 1.16 (a)) whose resolution is ~10 times higher than that of conventional reflection profiles. Using information regarding amplitude decay of surface waves, we firstly estimated the 3D attenuation coefficient and detected localized heterogeneity in shallow geological formations (Figs. 1.16 (b) and (c)). Our study also showed that seismic attenuation is sensitive to the localized fracture (crack), compared to the S-wave velocity. This is the first result to identify the localized heterogeneity using surface waves in an actual CO_2 storage site. The estimated heterogeneous structure can provide vital information for CO_2 geological storage, including evaluation of CO_2 leakage paths, estimation of permeability heterogeneity for CO_2 modeling, and enhances estimations of lithology strength used to prevent CO_2 injection induced seismicity.

This accomplishment represents progress close to the realization of the short-term milestone on “Field-scale reservoir characterization in heterogeneous formation” in the division’s roadmap for Project 2: Injected CO_2 monitoring and Field-scale investigation of CO_2 behavior.

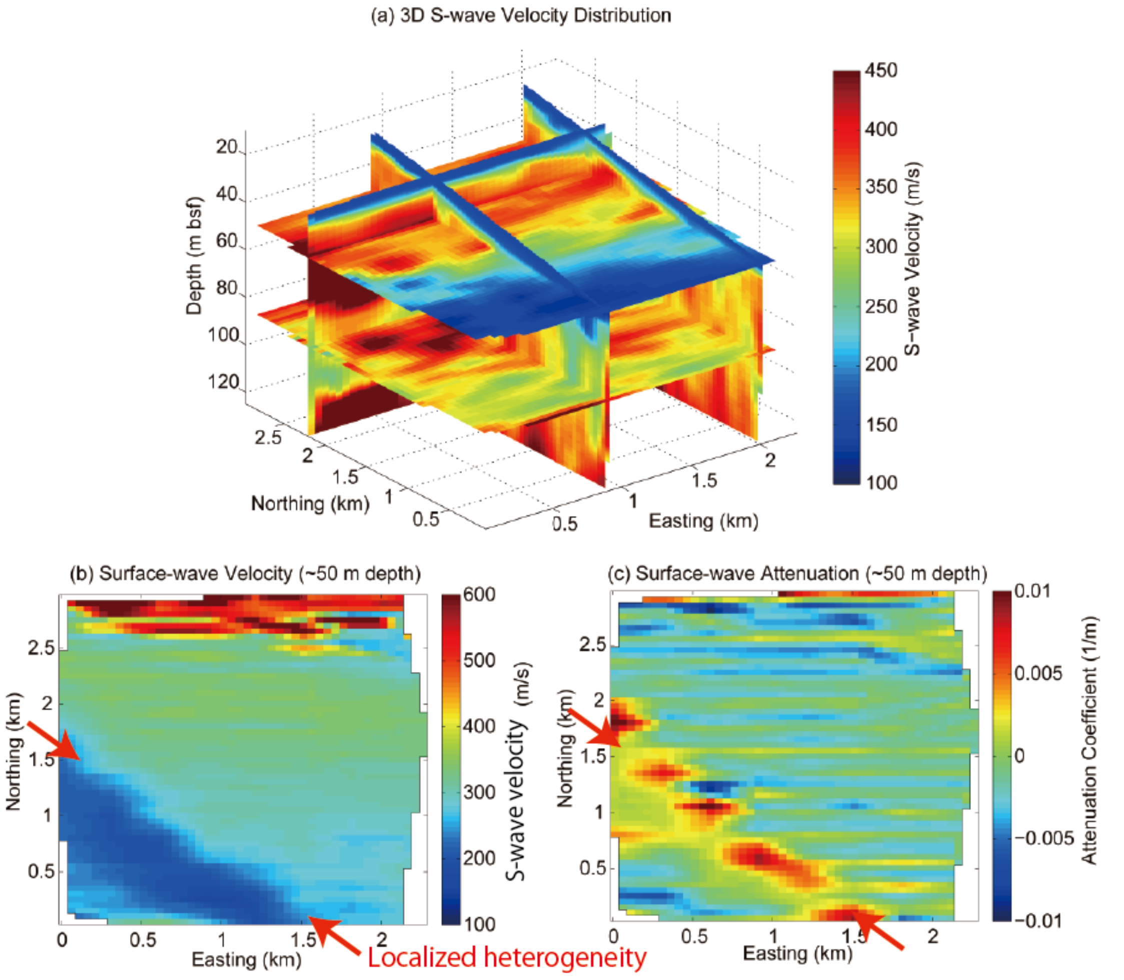


Fig. 1.16. (a) The estimated 3D S-wave velocity model in the Tomakomai CCS project site. Horizontal slices (map-views) of the (b) estimated surface-wave phase velocities and (c) attenuation coefficients at 2 Hz (~ 50 m depth from the seafloor). We firstly reveal NW-SE lithological boundary in this CCS site.

Publications

T. Ikeda, T. Tsuji, Advanced surface-wave analysis for 3D ocean bottom cable data to detect localized heterogeneity in shallow geological formation of a CO_2 storage site, International Journal of Greenhouse Gas Control, 2015 (DOI: 10.1016/j.ijggc.2015.04.020).

Energy Analysis (Acting Division Leader, Prof. Itaoka)

This division plays a critical role in I²CNER. It is responsible for providing carbon emission, energy efficiency, and cost analysis of current and emerging I²CNER and other energy processes, technology, and infrastructure. These analyses help ensure that I²CNER's and global energy related research are well targeted toward a carbon neutral society for Japan and the world as a whole. Also, in collaboration with the technical divisions, this division continuously reviews and revises the Institute's vision and roadmap toward a carbon-neutral society based on I²CNER and other energy system analyses.

Cost analysis of I²CNER's scenarios

To estimate the cost impact of implementing the I²CNER scenarios, the EAD developed a cost analysis module of electricity generation in Japan, adding to the energy model (technology bottom-up model) created in the previous year for the analysis of I²CNER's scenarios. The cost of a scenario is estimated as the difference between cost of energy supply, industrial activities, and transportation in a business as usual (BAU) scenario and those costs in each specific I²CNER scenario. The supply cost of energy includes the initial cost and operation cost, including fuel cost.

In the BAU scenario, we assumed that photovoltaics (PV) and wind power will increase following the historical trend; CCS will be deployed at a minimum level; and a fraction of existing nuclear plants will restart while no new plants beyond the plants under construction will be used. As we expected, we found the BAU scenario had the lowest cost. Among the other large emission reduction scenarios, excluding the "nuclear maintaining" scenario, which has yet great uncertainty regarding cost estimation on the back end, the "renewable scenario" is the least expensive in 2050 due to future cost reduction of PV. Meanwhile, the "renewable + battery" scenario, in which substantial battery power is required to mitigate the intermittency of PV and wind power is the most expensive in 2050 (Figure 1.17). This implies R&D should pursue not only cost reduction of renewables, but also technology to avoid negative impact on the quality of grid electricity due to the intermittency of PV and wind power, such as energy storage and dynamic demand response technology.

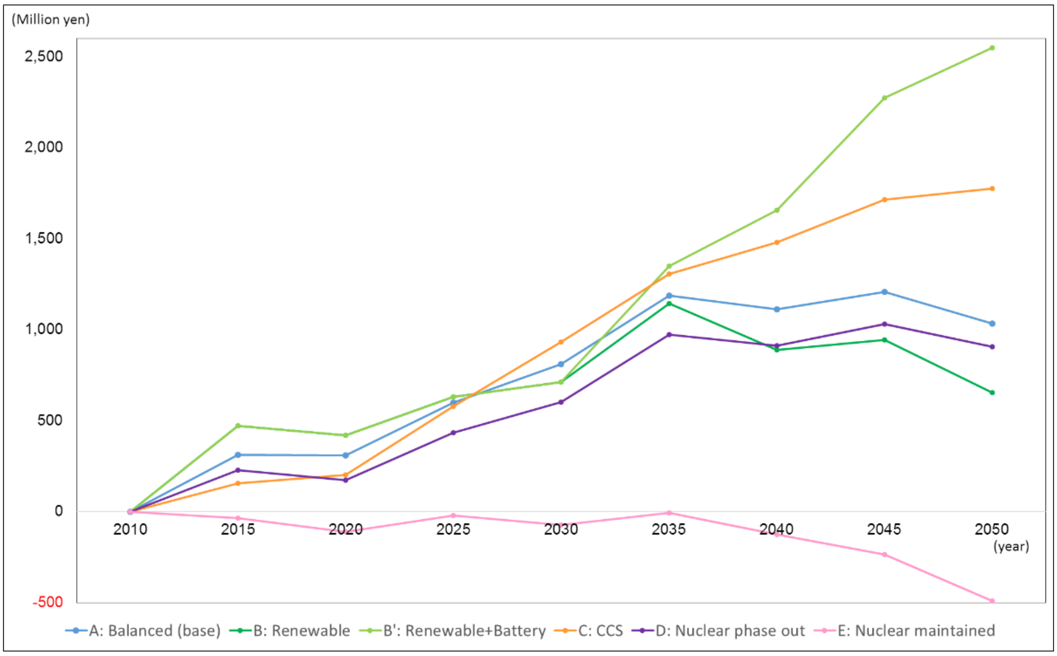


Fig. 1.17: Cost analysis of I²CNER's scenarios

Publication

K. Itaoka, S. Kimura, Energy technology analyses for deep GHG emission reduction by 2050 in Japan, Proceeding of Annual Conference 2014 of the Society for Environmental Economics and Policy Studies.

2. Advancing fusion of various research fields

I^2CNER has undertaken multiple initiatives to advance fusion research, the primary one being the I^2CNER Competitive Funding Program for young I^2CNER researchers. The specific objective of the program is to foster interdisciplinary research and nurture young faculty and postdocs. The stringent criteria for the program include relevance to the I^2CNER roadmap and a demonstrated potential for high-impact results. Participation in the program required proposal submission from young faculty and postdocs who have not collaborated with one another previously, and who have not had joint journal publications over the last two years. In FY 2014, the Director decided to require recipients of I^2CNER Competitive Funds to give a progress report 3 times per year to keep the I^2CNER Administration updated on the status of their interdisciplinary research projects. The success of the Competitive Funding Program will be assessed at the end of FY2015. Other efforts which encourage interdisciplinary research include the WPI Faculty Fellows Program (for full details, please see Section 3), the Institute Interest Seminar Series (for full details, please see Section 3), Collaborative Division Retreats (including more than 1 of I^2CNER's divisions), and informal, young faculty-led seminars.

Our annual symposium this year focused on fuel generation and use. It was a symposium in which the leaders of the international scientific community came together and discussed interdisciplinary approaches to tackle key themes of I^2CNER's roadmap: polarization in relation to the defect structure of the material components; the catalytic activity dependence on the surface structure and grain boundary species diffusion; dependence of the oxygen reduction reaction on proton transfer in non-precious catalysts; molecular design and dopant effects on stability for thermally activated delayed fluorescence; and the suggestion by Prof. Kunitake that we could consider amorphous membranes for fuel cells. Following this workshop, each of the I^2CNER's research divisions ran similar workshops specifically focused on the interdisciplinary aspects of their research objectives. Indeed, it was a full week of interaction and debate over interdisciplinary research methodologies.

An outcome of the annual symposium and individual division workshops is that in FY 2015, I^2CNER plans to host a workshop to explore cross-cutting themes for computational science, including catalysis, degradation, and select defect behaviors in order to discern what computational questions/problems I^2CNER should address in the future. Possible deliverables for this workshop will include a "basic needs" report on I^2CNER's computational science needs, which will serve as a prelusive roadmap for this effort; new interdisciplinary projects with computational elements; and improvements upon existing projects of the Institute through the addition of computational components (synergy). There are ongoing preliminary considerations for this workshop to be followed by one on "applied math for energy," which would follow a similar structure.

To further strengthen research collaboration between Kyushu and the Illinois Satellite, an interdisciplinary research grant was approved through the Competitive Funding program to foster the Sakai Group collaboration with Prof. Sharon Hammes-Schiffer, who is a world-renowned expert in the area of computational chemistry studies of molecular electrocatalysts for water oxidation and reduction. PI Sakai' s group developed a new active water reduction catalyst, based on nickel dithiolate, and examined its electrochemical properties in order to understand the factors that lower the overpotential for water reduction, and ultimately fabricate a much more highly active catalyst for technology applications. The major part of the grant was used to introduce two sets of new 16-cored computational clusters (HPC-ProServer DPeT630/2667v3D128GRD21, CPU : E5-2667v3 (3.2GHz/16 Cores), Gaussian 09 pre-installed servers). The bridge for this collaboration is graduate student Keita Koshiba, who already visited Illinois with PI Sakai March 5-13, 2015, to get the collaboration started. Under the guidance of Prof. Hammes-Schiffer, the major reaction pathway leading to the observed electrocatalytic hydrogen generation from water with this molecular catalyst are being studied through density functional theory (DFT) calculations.

The Center's best interdisciplinary accomplishments by division are as follows:

i) Hydrogen Production: In collaboration with the Ishihara Group at Kyushu University, Prof. Xiuling Li has applied her remarkable MacEtch process for highly anisotropic wet etching of semiconductors to the fabrication of unique nanostructures that can potentially serve as outstanding material for photo electrochemical cells (*Solid State Physics, Materials Science, Analytical Chemistry and Surface Science*).
ii) Hydrogen Materials Compatibility: A new fracture mechanics model for rolling contact fatigue

prediction was developed. This achievement impacts the reliable deployment of wind power generators by providing a state-of-the-art model for predicting the fatigue strength of bearings (*Metal fatigue, fracture mechanics, and tribology*)

iii) Fuel Cells: A well-defined system for electrochemical CO_2 reduction which utilizes Ag as the catalyst to reduce CO_2 to CO has been established by the CO_2 Capture and Utilization division. The Fuel Cell division developed a method to stabilize Pt-based electrocatalysts on carbon nanotube (CNT) for fuel cell applications. The observed onset potential for CO production was at a cell potential of -1.5 V comparable to the lowest found in the literature, and substantially better than that found using a Pt anode catalyst. The current density of 300 mA/cm^2 at -3.25 V cell potential is approaching that required for technology applications (*Cell technology and CNT-based novel Au electrocatalyst*)

iv) Thermal Science and Engineering: The reduction of lattice thermal conductivity is a critical goal of research on improving the thermal efficiency of thermoelectric materials for power generation from low grade heat sources. Silicon is earth abundant and the power factor of heavily doped Si is high, but the high lattice thermal conductivity prevents the use of silicon as a thermoelectric material. The lattice thermal conductivity of bulk crystalline silicon reduced by a factor of up to 20 when subjected to intense plastic strain under a pressure of 24 GPa using high-pressure torsion (HPT). (*Thermal science, material science, mechanical behavior)*

v) Hydrogen Storage: Carbon-based hydrogen storage materials is an entirely new class of potential candidates for on board hydrogen storage. PI Akiba and Prof. Hayashi of the Fuel Cells division have successfully designed the microstructure of such a carbon-based material with regard to the pore size, pore distribution and hydrophilicity/hydrophobicity. The technological impact of this new class of materials is that they operate below room temperature and do not need heat supply for the release of hydrogen (*Synthetic Chemistry, Surface Science, Materials science*).

vi) Catalytic Materials Transformations: Complementing their earlier work on the storage of hydrogen as formic acid, PI Ogo and his group have discovered a bio-inspired catalyst that converts formic acid into hydrogen; together, the processes define ways to store hydrogen as a liquid at room temperature and ambient pressure.

vii) CO_2 Capture and Utilization: We showed that high Faradaic efficiency (=selectivity) for CO and high utilization of CO_2 can be achieved with a dilute CO_2 feed, so flue gas from a power plant can be used directly as the feed for electroreduction of CO_2 to CO, thus eliminating the energy intensive process of CO_2 separation from flue gas (*Electrochemistry and Energy Saving System Process Optimization)*.

viii) CO_2 Storage: Integrated experimental and numerical efforts identified key links between CO_2 migration in heterogeneous rock formations and elastic wave velocity measurements at the core scale that could potentially provide a new and robust method for monitoring CO_2 fate in actual reservoirs. Further, the numerical simulations confirmed that the small-scale heterogeneity characteristic of actual rock can actually provide an effective trap of CO_2 to increase the integrity of CO_2 storage (*fluid dynamics and geophysics, using both laboratory experiments and numerical simulations*).

In the following the Center's best interdisciplinary accomplishments are described in detail:

Hydrogen Production (Lead Principal Investigator: Prof. Ishihara)

Cd Doping of Cu Chalcopyrite Semiconductor Surfaces for Solar Cell Applications (Solid State Physics, Materials Science, Analytical Chemistry and Surface Science)

The nano-chemistry at the hetero-junction between CdS and Cu(In,Ga)Se_2 (CIGS), which determines the device performance, is the subject to considerable debate. This interdisciplinary research project seeks to clarify the composition of the interface by blending solid-state physics and thin film device fabrication (Prof. Rockett, UIUC) with expertise in surface analytical chemistry (Drs. Téllez and Druce, KU) and unique facilities at I^{2}CNER (i.e. Low Energy Ion Scattering spectrometry). The interface chemistry is critical to controlling the electron concentration at the heterojunction of solar cells made from these materials and is necessary to achieving a high voltage output from the device. By examining the atomic-scale movement of atoms at the single-atomic-layer level we can show how this doping process occurs. To begin the analysis we have conducted a detailed study of methods to clean the sample and have shown that low-energy ion sputtering is the most effective method to remove any surface contamination prior to analysis of the sample surface. We have then performed a series of analyses on samples from which the CdS has been removed by chemical etching. This process typically yields a surface with residual Cd present. However, preliminary LEIS analysis did not find significant Cd doping of the heterojunction using conventional methods to prepare the materials. This shows that the Cd doping in the junction may be laterally non-uniform. Other studies by the Rockett group have found that in some commercially-produced materials have significant Cd doping so relating the processing conditions to the level of doping is key to fabrication of efficient solar cells based on this material. The results of the study have been presented to the researchers at Solar Frontier, the world's leading manufacturer of CIGS solar cells, located in Tokyo to enhance their production process. The results also contribute to the short-term milestone of Hydrogen Production Division Project 1 (High Temperature Electrolysis) to increase the total H_2 formation efficiency of a photovoltaic powered electrolyser above 10 %.

Publication

H. Téllez, J. Druce, A. Hall, T. Ishihara, J. Kilner, A. Rockett, Low Energy Ion Scattering: Surface Preparation and Analysis of Cu(In,Ga)Se_2 for Photovoltaic Applications, Progress in Photovoltaics: Research and Applications, in press, (DOI: 10.1002/pip.2535).

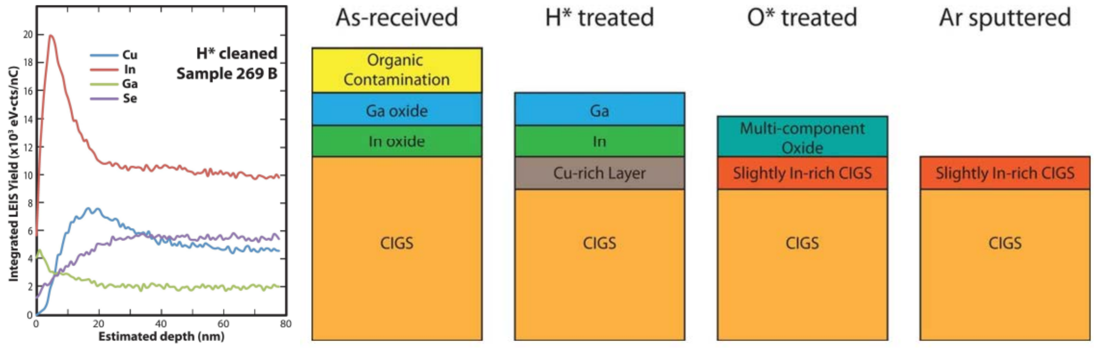


Fig.2.1. (Left) Depth profile for a hydrogen-cleaned CuInSe2 surface measured by low energy ion scattering (LEIS). The surface is highly enriched in In, underlying which is a Cu-rich region. (Right) A schematic illustration of the results of this study for methods of cleaning the sample surface and the anticipated compounds present in layers of the sample surface.

Fabrication of InP nanostructures using the MacEtch process (Solid State Physics, Materials Science, nano-machining and Surface Science)

Recently, an important Kyushu/Illinois collaboration was initiated in the hydrogen production division. This is the application of nanostructured semiconductors as photocatalysts. The work has been conducted as a collaboration between PI Ishihara and postdoc Guo at Kyushu University and Prof. Li at the University of Illinois. This collaboration has demonstrated the formation of highly anisotropic InP nanostructures with less than 20 nm feature sizes. The process is scalable to large areas and can be carried out at room temperature using the I-MacEtch method developed by Prof. Li. I-MacEtch is a unique and facile method to produce InP nanostructures, including linear, circular, and discrete features depending on the metal pattern, orientation, etchant composition, and etching time used. On the basis of extensive transmission electron microscopy and x-ray photoelectron spectroscopy characterization, Prof. Li's group has found that the inverse nature of the selective etching process is rooted in the formation of a thick oxide layer at the Au/InP interface that cannot be dissolved in the I-MacEtch solution. Remarkably, the sidewalls of the resultant nanostructures are not only nearly atomically smooth and free of porosity, but also are unaffected by the metal pattern edge roughness. I-MacEtch represents a highly economical and superior technique pertinent to the processing of various InP-based devices, including nanoscale field-effect transistors, solar cells, light emitters, and photocatalyst for modifying with organic dye. This interdisciplinary achievement represents progress toward the short-term milestone (Energy conversion efficiency >1%) of the division's Project 2: Photocatalytic water splitting through inorganic semiconductor for dye modified photocatalyst.

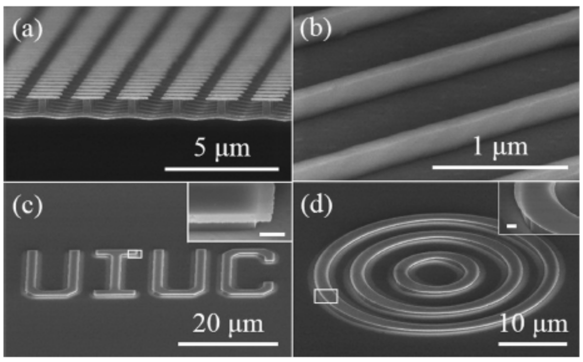


Fig. 2.2. InP nanostructures generated from I-MacEtch: (a) arrays of nanopillars generated from Pt square pads, (b) arrays of nanoscale fins from Au lines after Au removal, (c) the letters "UIUC" from Au pads with inset showing a high-magnification view of the outlined region (white box) corresponding to the letter "I", and (d) concentric InP microstructures generated from a set of Au rings, with inset showing the high-magnification view of the outlined region. The inset scale bars are 500 nm and metal catalyst layers were patterned by SL (a) and EBL (b–d).

Publication

S.H. Kim, P.K. Mohseni, J. Song, T. Ishihara, X. Li, Inverse Metal-Assisted Chemical Etching Produces Smooth High Aspect Ratio InP Nanostructures, Nanoletter, vol. 15, pp. 641-648, 2015.

Hydrogen Materials Compatibility (Lead Principal Investigator: Dr. Somerday)

A new fracture mechanics model for rolling contact fatigue (metal fatigue, fracture mechanics, and tribology)

The interdisciplinary achievement described below represents progress toward the milestone of developing models of mechanical and chemical processes relevant to tribo-failures and tribo-film formation. This short-term milestone is featured in Project 4: Environmental Effects on Friction and Tribological Failures.

In support of renewable energy development, a number of wind power generators have been constructed world-wide. Recently, the flaking fractures of large-scale bearings used in the generator, e.g., 0.4 m to 1 m outer diameter, have been frequently reported. The failure of bearings causes a significant economic loss since replacement of the large bearing mounted in the nacelle is costly. In such a situation, a novel strength-design method, which enables precise prediction of the fatigue strength, is required to enhance reliability.

In order to provide a solution, Prof. Matsunaga (WPI Professor) led an effort to establish a novel testing method to measure the threshold stress intensity factor ranges, ΔK_{IIth} and $\Delta K_{\mathrm{IIIth}}$, for the shear-mode growth of small cracks. The results were embedded in a new fracture mechanics model suggested by collaborators with expertise in metal fatigue (Prof. Matsunaga, WPI Professor), tribology (Komata, NSK Ltd.), and fracture mechanics (Prof. Yamabe, WPI Associate Professor). This interdisciplinary collaboration incubated the novel method for evaluating the rolling contact fatigue strength of bearings with arbitrary shapes, dimensions, and material cleanliness, as shown in Fig. 2.3. In the past, such a fracture mechanics-based method has not successfully predicted the flaking failure of bearings, since it requires an interdisciplinary approach, i.e., measurement of growth-resistance of small shear-mode fatigue cracks as a function of crack size, establishment of rolling contact fatigue test methods using specimens with small defects having various sizes and depths, and the proper modeling of rolling contact fatigue phenomena based on fracture mechanics. As research products, three domestic patents were filed: one for a newly developed fatigue testing machine and the other two for the novel strength-design method. In the future, the design-method will be generalized for different hydrogen content in the material as well as different microstructures, e.g., bainitic structure.

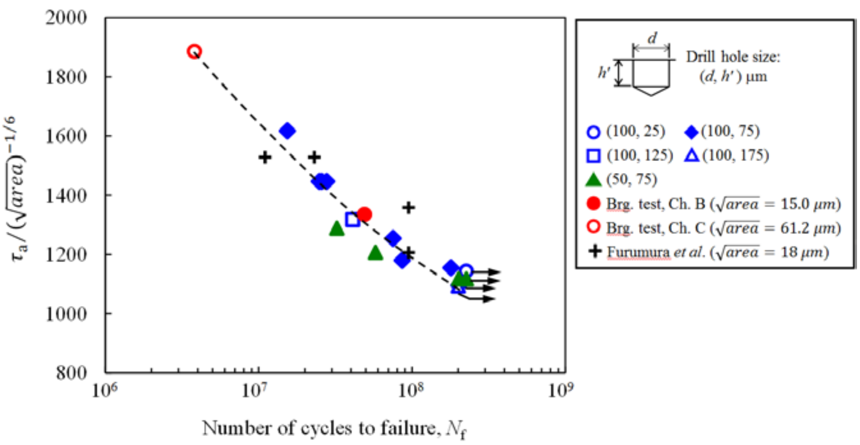


Fig. 2.3. Modified stress amplitude vs. cycles to failure diagram for rolling contact fatigue.

Publications

S. Okazaki, H. Matsunaga, T. Ueda, H. Komata, M. Endo, A practical expression for evaluating the small shear-mode fatigue crack threshold in bearing steel, Theoretical and Applied Fracture Mechanics, vol. 73, pp. 161-169, 2014.

H. Matsunaga, H. Komata, J. Yamabe, Y. Fukushima, S. Matsuoka, Effect of size and depth of small defect on the rolling contact fatigue strength of bearing steel JIS-SUJ2, Procedia Materials Science, vol. 3, pp. 1663-1668, 2014.

Prediction of subcritical crack propagation under sustained load (solid mechanics and mechanical metallurgy)

The interdisciplinary achievement described below represents progress toward the milestone of refining crack velocity vs. load models based on enhanced understanding of hydrogen-induced degradation in steels. This short-term milestone is featured in Project 3: Fracture and Fatigue Prognosis of Hydrogen Containment Systems.

Failure of hydrogen containment components is generally associated with subcritical cracking. Understanding subcritical crack growth behavior and its dependence on material and environmental variables can lead to more rigorous life-prediction models for structural components in hydrogen environments. In order to identify the issues underlying crack propagation and arrest, we developed a model for hydrogen induced stress-controlled crack propagation under sustained loading. The model was based on the assumptions that i) hydrogen reduces the material fracture strength and ii) crack propagation takes place when the opening stress over the characteristic distance ahead of a crack tip is greater than the local fracture strength. Formulating the modeling framework and its assumptions followed an interdisciplinary approach, in which the solid mechanics foundation is fully informed by mechanical metallurgy.

The model was used in a finite element simulation of crack propagation coupled with simultaneous hydrogen diffusion in a model material. The crack propagation model employed a nodal release technique in a simulated wedge opening load (WOL) specimen under constant displacement loading assuming plane strain conditions. The predicted crack velocity as a function of stress intensity factor (V-K curve) exhibited both stage I and II, which is characteristic of subcritical cracking (see Fig. 2.4). More importantly, both stage I and stage II of the V-K curve were captured through one mechanism of crack propagation, i.e. diffusion controlled crack propagation. This result suggests that it may not be necessary to treat stage I and II of the V-K curve differently in terms of mechanism-based modeling, which may allow advancements in models that are currently limited to stage II. Such advanced models are an essential component in state-of-the-art structural health monitoring systems applied to hydrogen containment components.

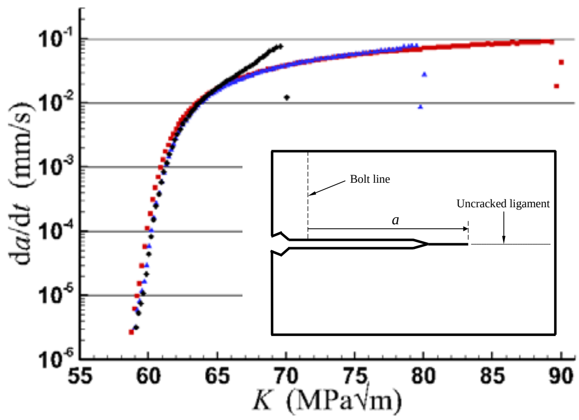


Fig. 2.4. Finite element simulation of crack velocity vs. stress intensity factor (V-K curve) for wedge opening load (WOL) specimens loaded to the initial stress intensity factors of 70, 80, and 90 MPa√m prior to hydrogen gas exposure. The inset shows a schematic of the simulated WOL specimen.

<u>Publication</u>

M. Dadfarnia, B.P. Somerday, P. Schembri, P. Sofronis, J.W. Foulk, III, K.A. Nibur, D.K. Balch, On modeling hydrogen induced crack propagation under sustained load, JOM, vol. 66, pp. 1390-1398, 2014.

Fuel Cells: (Lead Principal Investigator: Prof. Sasaki)

Electrochemical CO_2 reduction (Cell technology and CNT-based novel Au electrocatalyst)

The Paul Kenis group at the University of Illinois established a well-defined system for electrochemical CO_2 reduction, which utilizes Ag as the catalyst to reduce CO_2 to CO. The group of Prof. Nakashima in the Fuel Cell division developed a method to stabilize Pt-based electrocatalysts on carbon nanotube (CNT) for fuel cell applications. The metal nanoparticle stabilization methodology is generally applicable to a wide variety of nanoparticle materials, including those relevant to CO_2 reduction such as Ag and Au.

This research combines CNT-based supports with metal electrocatalysts for CO_2 reduction, and investigates the effect of the support on reactivity. We combined the best cathode (MWNT/PyPBI/Au; Fig. 2.5: left) with the best anode (IrO_2) to maximize the performance obtained for the electrochemical reduction of CO_2 to CO. The observed onset potential for CO production was at a cell potential of -1.5 V comparable to the lowest found in the literature (Fig. 2.5) and substantially better than that found using a Pt anode catalyst. The current density of 300 mA/cm^2 at -3.25 V cell potential is approaching that required for practical applications. This interdisciplinary achievement represents progress toward the short term milestone on durability and performance of electrocatalysts in Project 1 in the division roadmap.

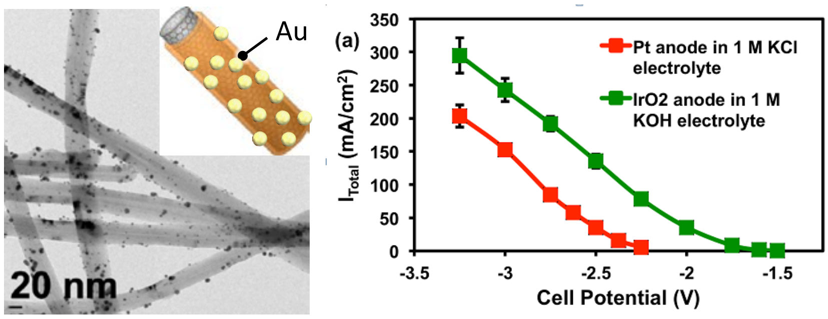


Fig. 2.5. (left) TEM image of MWNT/PyPBI/Au and (right) Total current density for CO when using different anode catalysts (cathode: 0.34 mg/cm^2 MWNT/PyPBI/Au catalyst painted on gas diffusion electrode).

<u>Publication</u>

H-R. Jhong, C.E. Tornow, C.R. Kim, J.L. Oberst, P.S. Anderson, A.A. Gewirth, T. Fujigaya, N. Nakashima, and P.J.A. Kenis, Gold Nanoparticles on Polymer-Wrapped Carbon Nanotubes: An Efficient and Selective Catalyst for CO_2 Reduction, (Submitted).

Thermal Science and Engineering (Lead Principal Investigator: Prof. Takata)

Thermal conductivity of suspended submicron graphene ribbons (thermal science and materials science)

Thermophysical characterization of graphene is very important for both fundamental and technological research in relation to various energy devices. In particular thermal conductivity measurements of graphene ribbons are still very few. The temperature dependent thermal conductivity of a 169-nm wide and 846-nm long graphene ribbon has been investigated by the electrical self-heating method. The measured thermal conductivities range from (12.7±2.95) W/m/K at 80K to (932±333) W/m/K at 380 K, being (349±63) W/m/K at 300 K, following a $\sim T^{2.79}$ law for the full temperature range of 80K to 380K and a $\sim T^{1.23}$ law at low temperatures. The comparison of the measured thermal conductance with the ballistic transport limit indicates diffusive transport in this narrow and short ribbon due to phonon-edge as well as phonon-defect scattering. The data were also combined with an empirical model to predict possible width dependence of thermal conductivity for suspended graphene ribbons. These results help understand the 2D phonon transport in suspended submicron graphene ribbons and provide knowledge for controlling thermophysical properties of suspended graphene nanoribbons through size manipulation. This interdisciplinary achievement represents progress toward the short-term milestone of the development of measurement methods of physical properties of individual nanomaterials in the division's Thermophysical Properties Project 3 in the division roadmap.

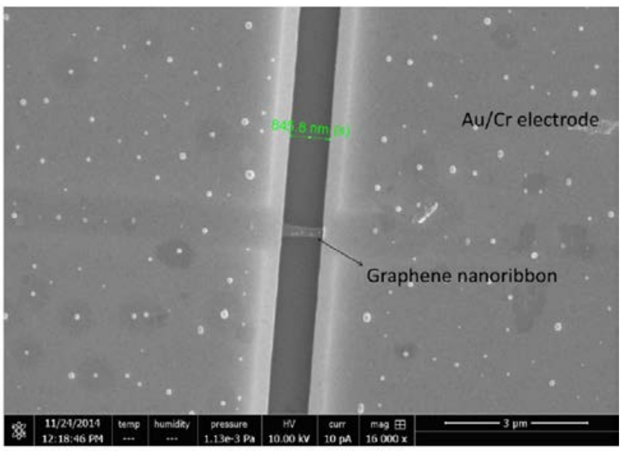


Fig. 2.6. SEM images of the suspended graphene ribbon (169×846 nm)

Publication
Q.-Y. Li, K. Takahashi, H. Ago, X. Zhang, T. Ikuta, T. Nishiyama, K. Kawahara, Temperature dependent thermal conductivity of a suspended submicron graphene ribbon, Journal of Applied Physics, vol. 117, No. 065102, 2015.

Reduction of thermal conductivity of crystalline silicon by high-pressure torsion (thermal science and materials science)
We report a dramatic and irreversible reduction in the lattice thermal conductivity of bulk crystalline silicon when subjected to intense plastic straining under pressure of 24 GPa by high-pressure torsion (HPT). Thermal conductivity of the HPT-processed samples were measured using picosecond time domain thermoreflectance. Thermal conductivity measurements show that the HPT-processed samples exhibit a lattice thermal conductivity reduction by a factor of approximately 20 (from intrinsic single crystalline value of 142 $Wm^{-1}K^{-1}$ to approximately 7.6 $Wm^{-1}K^{-1}$). Thermal conductivity reduction in HPT-processed silicon is attributed to the formation of nanograin boundaries and metastable Si-III/XII phases which act as phonon scattering sites, and the presence of a large density of lattice defects introduced by HPT processing. Annealing the samples at 873 K increases the thermal conductivity due to the reduction in the density of secondary phases and lattice defects. This interdisciplinary achievement represents progress toward the short-term milestone of the development of experimental techniques for interfacial thermal transport in the division's Thermophysical Properties Project 3 in the division roadmap.

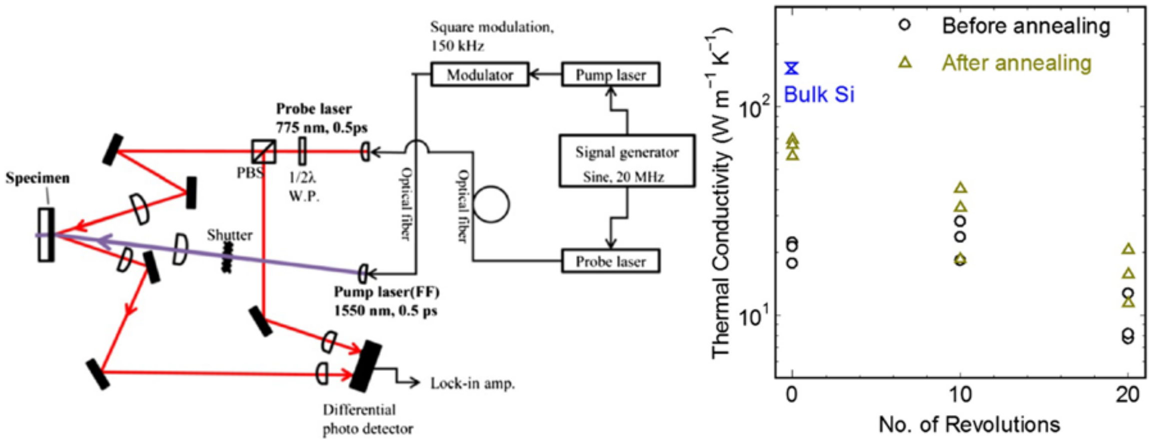


Fig. 2.7. (Left) Schematic of the picosecond time domain thermoreflectance setup. The violet and red lines show the optical transport path of the pump beam and probe beam. (Right) Thermal conductivities of the HPT-processed before and after annealing. An order of magnitude reduction in the thermal conductivity of Si upon HPT processing is observed. Annealing of the HPT samples show an increase in thermal conductivity due to the reverse transformation of metastable phases to Si-I cubic diamond phase.

Publication
S. Harish, M. Tabara, Y. Ikoma, Z. Horita, Y. Takata, D.G. Cahill, M. Kohno, Thermal conductivity reduction of crystalline silicon by high-pressure torsion, Nanoscale Research Letters, vol. 9, No. 326, 2014.

Hydrogen Storage (Lead Principal Investigator: Prof. Akiba)

Nanoporous materials as hydrogen storage media (Synthetic Chemistry, Surface Science, Materials science, and Hydrogen storage)
High surface area materials have attracted attention as potential hydrogen storage media because their storage capacity can reach more than several wt%. The US DOE envisions the high surface area materials as potential candidates for on board hydrogen storage. These materials operate below room temperature and do not need heat supply for the release of hydrogen. The design of the structure of high surface area is key to the development of hydrogen storage materials with enough capacity. The hydrogen storage division collaborates with Prof. Akari Hayashi of the Fuel cell division, an expert on carbon based materials, to create these new hydrogen absorbers. We have successfully designed the microstructure of a carbon-based material with regard to the pore size, pore distribution and hydrophilicity/hydrophobicity. We expect these materials to show favorable hydrogen absorbing properties and by tuning the microstructure we expect that we will achieve optimal hydrogen storage.

This interdisciplinary achievement represents progress toward the 5% wt short-term milestone of the division's Project 1: On board hydrogen storage.

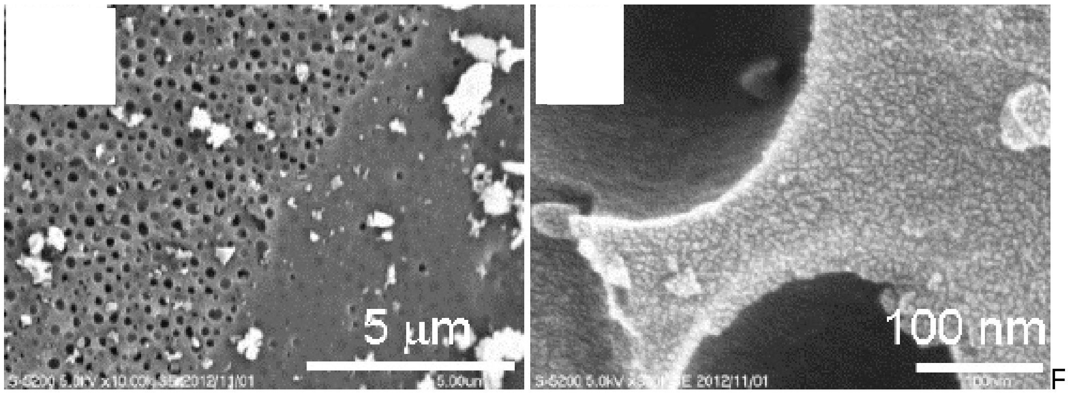


Fig. 2.8. SEM images of carbon materials synthesized by 50:50 mole ratios of resorcinol and 2,6-dihydropyridine hydrochloride.

Publication

Y. Sonoda, A. Hayashi, Y. Minamida, J. Matsuda, E. Akiba, Nanostructure Control of Porous Carbon Materials through Changing Acidity with a Soft-Template Method, Chemistry Letters, vol. 44, pp. 503-505, 2015.

Catalytic Materials Transformations (Lead Principal Investigator: Prof. Ogo)

A [NiFe]hydrogenase Model That Catalyses the Release of Hydrogen from Formic Acid (Bioinorganic Chemistry, Biochemistry, Coordination chemistry)

We report the decomposition of formic acid to hydrogen and carbon dioxide, catalysed by a NiRu complex originally developed as a [NiFe]hydrogenase model. This is the first example of H_2 evolution, catalysed by a [NiFe]hydrogenase model, which does not require additional energy. The catalyst plays the maximum value of turnover numbers (TONs, mol of H_2 evolved/mol of catalyst) of H_2 evolution is 857 for 1 h at 60^{o}C at pH of 3.5. This is first [NiFe]hydrogenase model complex have been reported catalyzed for hydrogen production at ambient conditions, this model displays formate hydrogenlyase function without any need for additional energy input.

Building on previous biochemical studies published in 2014, we have achieved the short term milestone of isolating formate dehydrogenase and its model complex for CO_2 conversion. This achievement is part of the division's larger project on the development of novel biomimetic catalysts for H_2, CO_2, and H_2O activation based on naturally occurring enzymes (Project 1). This work is the benchmark in this area.

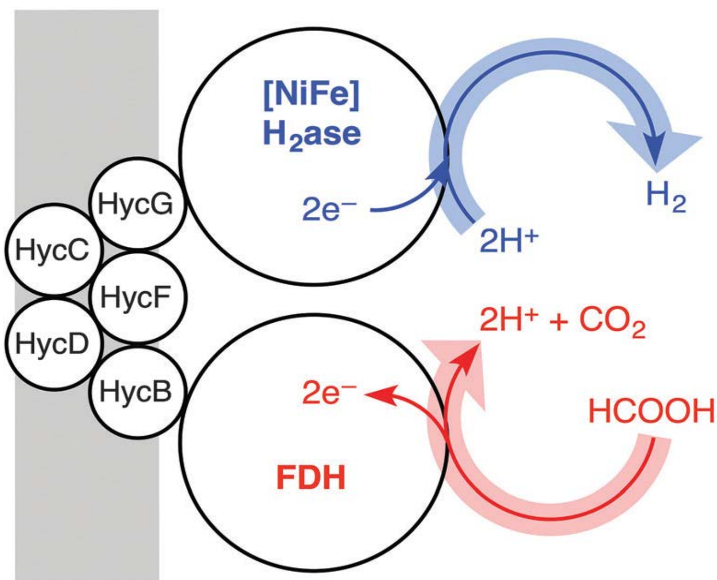


Fig. 2.9. A structure of formate hydrogen lyase (FHL) constructed from a [NiFe]hydrogenase ([NiFe]H2ase) and a formate dehydrogenase (FDH).

Publication
N.T. Nguyen, Y. Mori, T. Matsumoto, T. Yatabe, R. Kabe, H. Nakai, K.S. Yoon, S. Ogo, A [NiFe]hydrogenase model that catalyses the release of hydrogen from formic acid, Chem. Commun., vol. 50, pp. 13385–13387, 2014.

Ruthenium-Catalyzed Oxidative Kinetic Resolution of Unactivated and Activated Secondary Alcohols with Air as the Hydrogen Acceptor at Room Temperature. (Organic chemistry, Oxidation Chemistry, Asymmetric Catalytic Chemistry
Dioxygen (O_2) is a highly abundant, ubiquitous, and most efficient oxidant on the earth. However, the activation of O_2 required the addition of co-reductant, hearting, and pressurizing conditions in the chemical way. Recently, we found that ruthenium(aqua)-salen derivatives were efficient catalyst for the activation of O_2 under mild conditions. Herein, we could present that first example of aerobic oxidative kinetic resolution of unactivated secondary alcohols such as 2-ocatanol. The reaction carried out with good-to-high enantiomer differentiation using O_2 in air as a hydrogen acceptor.
Building on previous catalytic aerobic oxidation using iron or ruthenium complexes, we have achieved the short-term milestone of non-energy requiring aerobic oxidation. This achievement is part of the division's larger project on the energy conservation in material transformation (Project 2). This accomplishment is a monumental piece of work in the aerobic oxidative material transformation.

Publication
H. Mizoguchi, T. Uchida, T. Katsuki, Ruthenium-Catalyzed Oxidative Kinetic Resolution of Unactivated and Activated Secondary Alcohols with Air as the Hydrogen Acceptor at Room Temperature, Angew. Chem. Int. Ed. Vol. 53, pp. 3178-3182, 2014.

CO_2 Capture and Utilization (Lead Principal Investigator: Prof. Fujikawa)

Feasibility of using flue gas as a direct feed for efficient electroreduction of CO2 to CO (Electrochemistry and Energy Saving System Process Optimization)
We studied the effect of different CO_2 streams (e.g., the ~ 15% CO_2 in flue gas) on cathode performance in CO_2 reduction. Also, we examined and compared the effect of pH on performance with the effect variable CO_2 concentration. This study highlights that high Faradaic efficiency for CO and high utilization of CO_2 could be achieved at dilute CO_2 feed, which implies that the direct use of flue gas as a feed for electrochemical reduction to CO has promise.
One of the short term milestones of the division's Project 2 is to optimize important parameters in CO_2 reduction (e.g., Faradaic efficiency, current density and energetic efficiency). The use of flue gas directly as the feed for CO_2 reduction processes can possibly sidestep the energy intense of CO_2 capture and concentration so that we can increase overall energy efficiency of CO_2 reduction processes.

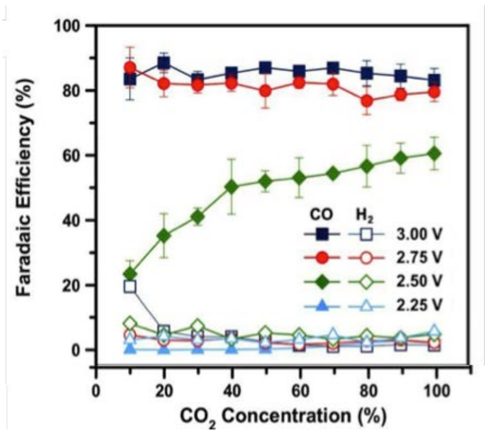


Fig. 2.10. Faradaic efficiency for CO and H_2 as a function of CO_2 concentration

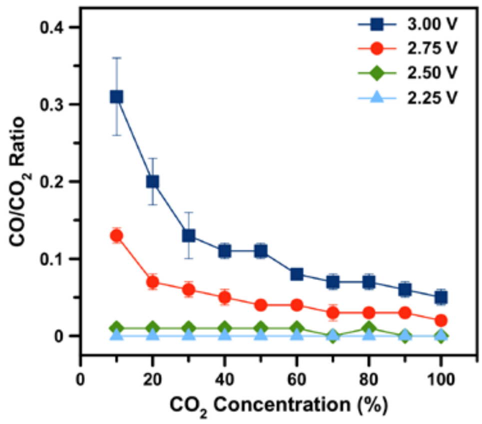


Fig. 2.11. Ratio of CO over CO_2 as a function of CO_2 concentration

Publication
B. Kim, S. Ma, H.R. Jhong, P.J.A. Kenis, Influence of dilute feed and pH on electrochemical reduction of CO_2 to CO, Electrochimica Acta, vol. 166, pp. 271-276, 2015.

CO_2 Storage (Lead Principal Investigator: Prof. Tsuji)

Two-phase flow within heterogeneous pore structure (fluid dynamics and geophysics, using both laboratory experiments and numerical simulations)

We revealed that two-phase fluid flow (CO_2 and water) is strongly controlled by small-scale heterogeneity in porous sandstone by (i) the measurement of elastic wave velocity at the sub-core scale (mm-cm; Fig. 2.13 (a)) and (ii) the two-phase fluid-flow simulation based on the Lattice-Boltzmann-Method at the pore-scale (nm-mm; Fig. 2.13 (b)). The lamina is a typical small-scale heterogeneity in the porous sandstone and has a smaller pore-size distribution than the surrounding porous zone. The geophysical observations indicate that CO_2 cannot pass through the lamina-rich zone in water-saturated porous sandstone. This restrictive CO_2 flow around the lamina-rich zone is caused by a gap in the pore pressure. These results highlight how it may be possible to accurately monitor the pore-scale CO_2 behavior external to the pore space using geophysical methods. This study also indicates that small-scale heterogeneity has a potential to be sub-sealed in the CO_2 reservoir and to increase the integrity of CO_2 storage. This work is related to Project (1) "Pore-scale investigation of CO_2 fate" of the CO_2 storage research division and addresses the short-term milestone "Model injected CO_2 behavior from laboratory experiment and simulation."
Benchmark: Current pore-scale models cannot capture dynamic nature of CO_2 migration nor do they embody the interconnected nature of the pore system and impact on CO_2 migration.

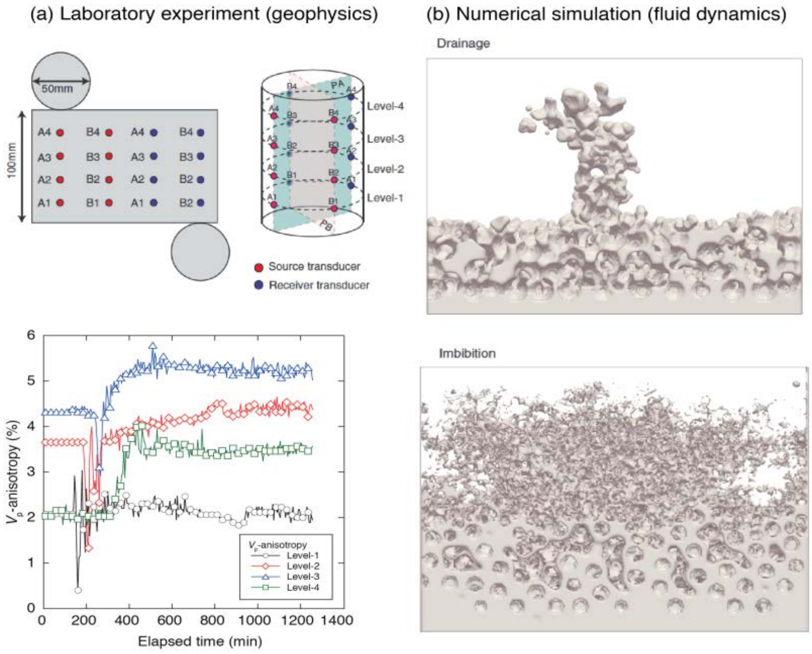


Fig. 2.12. (a) Geophysical observation to identify fluid flow along the lamina structure.
(b) Flow paths of drainage and imbibition process.

Publication
K. Kitamura, F. Jiang, A.J. Valocchi, S. Chiyonobu, T. Tsuji, K.T. Christensen, The study of heterogeneous two-phase flow around small-scale heterogeneity in porous sandstone by measured elastic wave velocities and lattice Boltzmann method simulation, Journal of Geophysical Research (Solid Earth), vol. 119, pp. 7564-7577, 2014.

Energy Analysis (Acting Division Leader, Prof. Itaoka)

Decentralized carbon-free hydrogen production through natural gas steam reforming along with on-site CO_2 capture and storage (CCS). (chemical engineering, geological physics and economic analysis)

The production of carbon-free hydrogen is a key technology associated with the commercialization of the fuel cell vehicles. Currently, hydrogen is mainly produced by steam reforming of natural gas (NSR), a process which involves CO_2 emissions. In this study, we analyzed the potential and possible cost-advantage of producing carbon-free hydrogen by NSR along with on-site CCS (Fig. 2.13) against hydrogen production through water electrolysis (WER). In the comparison between the two approaches, we accounted for the storage potential and monitoring costs for the injected CO_2. In particular, we analyzed CO_2 injection into shallow geological formations and prioritized the key methodologies for this CCS system. In addition, we accounted for the specific performance values of our developed separation membrane, such as gas flux, selectivity, cost of membrane, and usage period. Based on our system (Fig. 2.14) analysis, we concluded that NSR with a decentralized CCS system at the refueling stations has sufficient potential to produce reasonably priced carbon-free hydrogen. We also demonstrated that such a hydrogen production system constitutes a bridge technology for the establishment of a carbon-free hydrogen supply system based on reusable energy sources. This work addresses the final objective of the CO_2 Storage division: “Propose and realize innovative CCS concepts suitable for geological formations typical of Japan (i.e. tectonically active area).” However, CO_2 onshore storage has the potential to cause concern on behalf of the public, as demonstrated in the Netherlands, so social science studies will be necessary to gauge public perception of this technology.

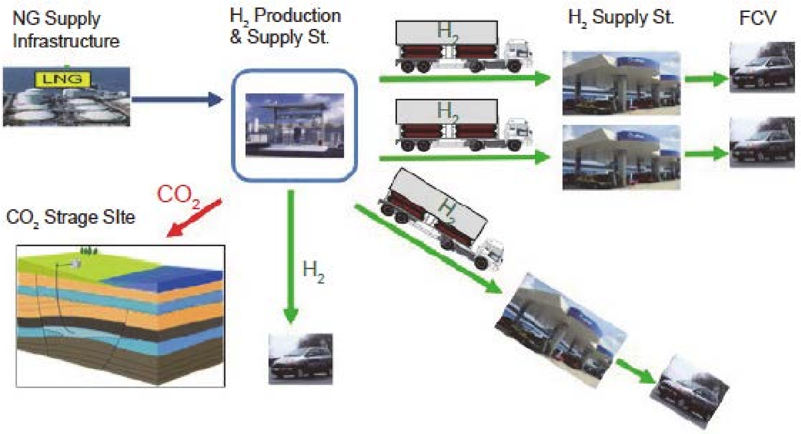


Fig. 2.13. Ideal carbon-free hydrogen supply system with decentralized natural gas reforming and on-site CCS.

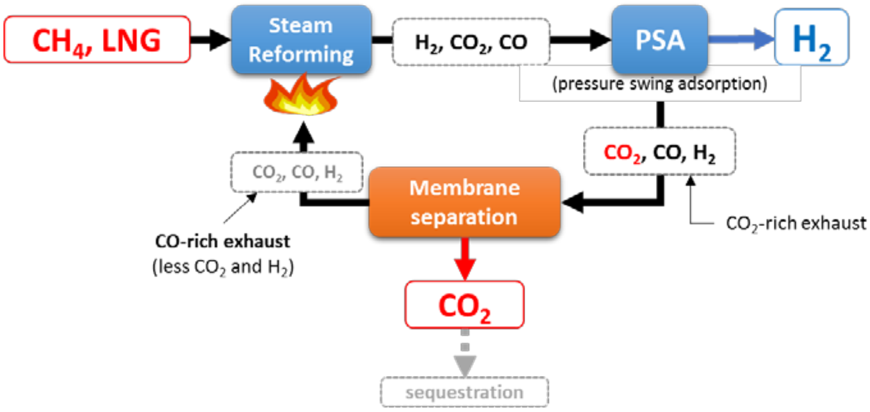


Fig. 2.14. Schematic diagram of CO_2 membrane capture and storage for H_2 from CH_4 or liquified natural gas (LNG): CH_4 or LNG is first converted to H_2 and CO_2 (and other gasses) by steam reforming. H_2 in this mixture gas is purified by PSA (pressure swing adsorption) which is the technology used to separate target gas species (H_2, in this case) from a mixture of gases by using solid absorbent materials and controlling pressure. After the PSA process, CO_2 is separated by a membrane from the exhausted gas stream for CO_2 sequestration. The rest of the gasses comprising mainly of CO (and small amount of CO_2 and H_2) can be used as a fuel gas for steam reforming.

Publication

S. Kimura, K. Honda, K. Kitamura, I. Taniguchi, K. Shitashima, T. Tsuji, S. Fujikawa, Preliminary Feasibility Study for On-Site Hydrogen Station with Distributed CO_2 Capture and Storage System, Energy Procedia, vol. 63, pp. 4575-4584, 2014.

3. Globalization of the institution

* Describe what’s been accomplished or recognized in the efforts to raise the center’s international recognition as a genuine top world-level research institute, along with innovative efforts proactively being taken in accordance with the development stage of the center, including the following points, for example:

- Efforts being developed based on the analysis of number and state of world-leading, frontline researchers; number and state of visiting researchers; exchanges with overseas entities
- Proactive efforts to raise the level of the center’s international recognition
- Efforts to make the center into one that attracts excellent young researchers from around the world (such as efforts fostering young researchers and contributing to advancing their career paths)

I^2CNER added the Air Resources Board of the State of California (CARB) to its network of international collaborating institutions in FY 2014. Negotiations for a memorandum of understanding in the general field of hydrogen technology between I^2CNER and the Helmholtz Zentrum Geesthacht (HZG) are underway. PI Akiba is already collaborating with researchers from HZG, e.g. from February-September 2015, HZG researchers will be working in Prof. Akiba's laboratory and a PhD student from HZG will visit I^2CNER in August 2015. In addition, there has been communication between the Director of I^2CNER, the Director of the Helmholtz Institute in Juelich, and PI Reiner Kirchheim to explore areas for possible collaboration between the two Institutes, in particular, in the areas of fuel cells, hydrogen production, storage, and delivery, and materials mechanical behavior. As of March 31, 2015, I^2CNER has a total of 23 partner institutions in the US, Europe, and Asia, of which, I^2CNER has agreements or MOUs with 4 (the University of Illinois, Norway SINTEF/NTNU, the Air Resources Board of the State of California (CARB), and the National Fuel Cell Research Center (NFCRC) at the University of California, Irvine). For the complete list of our international partner institutions, please see Appendix 3-1-2, "Satellites and partner institutions."

The researchers of the Institute have also had success at elevating the Institute's visibility on an individual level. By way of example, I^2CNER researchers hosted a grand total of 42 distinguished visitors to Kyushu University from the United States, Canada, Europe, Korea, China, South Africa, Australia, France, Norway, Japan, and the United Kingdom. The Institute's researchers were responsible for organizing or co-organizing 8 international conferences, 6 international conference sessions, and 9 I^2CNER international workshops. In addition, our researchers have joint publications with researchers from 26 institutions around the world.

Partnerships in International Research and Education (PIRE)

The I^2CNER Director and Professors Elif Ertekin and Narayana Aluru from UIUC's Department of Mechanical Science and Engineering are working together with Kyushu University Profs. Tatsumi Ishihara, Hiroshige Matsumoto, and Nicola Perry to submit a joint "Partnerships for International Research and Education (PIRE)" Proposal focused on computation to NSF/JSPS. The project has already passed the pre-proposal stage and has been invited for a full proposal, which is due May 15, 2015. The decision to submit the pre-proposal was catalyzed by the fact that Kyushu and Illinois already have an ongoing relationship through the I^2CNER project.

Air Resources Board of the State of California (CARB)

I^2CNER initiated collaborations with the Air Resources Board of the State of California (CARB), which was formalized by a "Letter of Understanding," signed on May 19, 2014. Our first discussion was held via teleconference on December 1, 2014. Since the initial discussion, there have been several exchanges of information between CARB and I^2CNER, including I^2CNER's roadmaps and descriptions of each division, in order to familiarize CARB with the Institute and vice versa. Several mutual areas of interest have been identified, including a systems' approach to a sustainable society, SOFC/SOEC cathodes using proton conducting oxides, and challenges related to implementation of SOFCs operating in low and high pressure applications at both a systems and materials level. It is expected that this collaboration will continue to be strengthened in FY 2015 and beyond. The degree of mutual interests between I^2CNER and CARB on renewable energy and the implementation thereof is demonstrated by the fact that CARB will hire one of the I^2CNER Satellite postdoctoral researchers, Dr. Xuping Li, beginning in FY 2015.

Interactions with the US Department of Energy (DOE)

- Dr. Somerday, the Division Lead PI of the Hydrogen Materials Compatibility Division, leads several research projects at Sandia National Laboratories that require interaction with Technology Development Managers (TDMs) at the US Department of Energy (DOE) Fuel Cell Technologies Office. In this capacity, Dr. Somerday is responsible for establishing and managing expectations for project objectives, milestones, and work progress through direct communication with the TDMs. A number of these projects which are focused on fundamental science are carried out at I^2CNER. As a result of his recognized technical expertise and ability to productively manage projects, DOE recently approved Dr. Somerday to assume another leadership role in a high-profile project titled H_2FIRST (Hydrogen Fueling Infrastructure Research and Station Technology), which emphasizes public-private cooperative R&D to stimulate the development of hydrogen fueling stations in the U.S.

- Director Sofronis is in communication with the Fuel Cells Technology Office and exchanges information about mutual interests, which includes visits to Washington, D.C. and serving as a reviewer for the Department of Energy in the Annual Merit Review and Peer Evaluation Meetings.
- I^{2}CNER was featured in a plenary lecture given by the Fuel Cell Technology Office at DOE's 2014 Annual Merit Review and Peer Evaluation Meeting on June 16, 2014.
- In FY 2014, former US DOE Energy Analyst Mark Paster was newly appointed as a member of the Institute's External Advisory Committee (EAC), after having played a vital role in the Energy Analysis Division (EAD).

National Fuel Cell Research Center (NFCRC)
In FY 2014, a delegation of I^{2}CNER researchers visited NFCRC for the first time. In addition, the visit by the Associate Director of NFCRC, Prof. Jack Brouwer, to the 2015 I^{2}CNER Annual Symposium set the stage for ongoing collaborations. NFCRC and I^{2}CNER collaborate on challenges related to implementation of SOFCs operating in low and high pressure applications at both a systems and materials level. In particular, a research collaboration on cathode and SOFCs/SOECs using proton conducting oxides is under consideration.

ECOSTORE
I^{2}CNER holds a four year consortium agreement with the ECOSTORE project, which is based in the European Union. The aim of the project is to bring together senior and junior scientists from in and outside of Europe through education about hydrogen storage. International exchange of young researchers is also a priority of the ECOSTORE. Prof. Estuo Akiba (Hydrogen Storage Division Lead Principal Investigator) serves as an Associated Partner on the project. A 2-day ECOSTORE workshop was held at Kyushu University in March 2015.

University of Oxford
The Director serves on the Strategic Advisory Panel of the Hydrogen in Metals—From the Fundamentals to the Design of New Steels (HEmS) at the University of Oxford.

Influence on National and International Policy
Prof. Etsuo Akiba is playing an important role in an international network for research and development of hydrogen storage materials as an expert adviser of Tasks 22 and 32 for Hydrogen Implementing Agreement in the International Energy Agency.

Prof. Kazunari Sasaki is a member of the Strategic Council of Hydrogen and Fuel Cell which was established in December 2013 by the Agency of Natural Resources and Energy. The aims of the council are (i) to hold their understandings among Industry, government and academia on significance of hydrogen energy and perspective of hydrogen demand in future, and (ii) to define role-sharing among industries and government and a roadmap to complete the sharing roles up to 2030 when global commercialization is estimated. Prof. Sasaki is one of three participating members from academia.

Prof. Takeshi Tsuji is a member of the committee of the Japan CCS Corporation which will decide the next CO_2 storage site around the Japanese Islands.

Collaborative Foreign Exchange Program
I^{2}CNER's "Collaborative Foreign Exchange Program" is in place in order to encourage young researchers, especially Japanese, to more actively visit our overseas collaborating institutions. The program requires that interested researchers submit a 2-page proposal to be reviewed by the SSC, and if approved, submit a 1-page summary report after the visit is complete. Researchers are also required to give a presentation in the Institute Interest Seminar Series (IISS) after the travel is complete. In FY 2014, 7 researchers (5 Japanese, 2 non-Japanese) had their proposals approved, 5 of which visited the Illinois Satellite. One of our female assistant professors visited Sandia National Laboratories for 6 months to collaborate with Dr. Somerday, the Lead PI of the Hydrogen Materials Compatibility Division.

WPI Faculty Fellows Program
In FY 2014, the Institute established a new WPI Faculty Fellows Program in order to encourage promising or eminent scientists from preeminent international universities and institutes to conduct short-term, onsite, interdisciplinary, institute-related research at Kyushu University/I^{2}CNER for periods of three to six months. The program is intended to help recruit foreign researchers who may consider

accepting permanent positions at I²CNER. In the future, our goal is to integrate this program with Kyushu University's newest initiatives, the Progress 100 Program and the Top Global University Project, in order to achieve synergy through sharing of resources.

I²CNER Seminar Series

In FY 2014, I²CNER engaged key members of the international community from: academia, national laboratories, industry, and policy makers in government agencies. In FY 2014, the Institute hosted a total of 24 speakers (15 non-Japanese) in 22 I²CNER Seminars. The Director already gathered input from the young faculty on how to improve the climate, and the following measure is being implemented:

- In order to make the visiting speakers more accessible to our young faculty, the Administration is implementing a "sign-up sheet" system, where any I²CNER researcher can request a meeting with visiting seminar speakers.

Institute Interest Seminar Series (IISS)

In order to advance interdisciplinary research amongst young researchers, the Institute regularly hosts the "Institute Interest Seminar Series (IISS)." A total of 24 speakers presented at 16 Institute Interest Seminars in FY 2014. The Director already gathered input from the young faculty on how to improve the climate, and the following measures are being implemented:

- The Administration plans to extend an open invitation to non-I²CNER young faculty within KU to participate in this seminar series in order to expand opportunities for collaboration for our young faculty.
- Question & Answer time will be extended to a half hour or more.
- More general research topics will be included, including social sciences or research ethics.
- Speakers will be encouraged to limit jargon and overly technical presentations in order to make the series marketable to an audience with a wide variety of scientific backgrounds.
- Some seminars in this series may be scheduled during lunch time to allow postdocs more time to participate in the discussion portion.

Role of the University of Illinois at Urbana-Champaign (UIUC) Satellite

From the very beginning, one of I²CNER's fundamental strategies for internationalization has been the Satellite Institute at the University of Illinois at Urbana-Champaign. The Illinois Satellite helps promote the Institute's overall international visibility through the participation of several world-leading researchers. In addition, the ongoing relationships between the faculty of Kyushu University and the University of Illinois at Urbana-Champaign are having a transformative impact upon I²CNER's overall research culture. Some of the efforts undertaken at the Satellite to promote the KU/UIUC relationship and the globalization of I²CNER are as follows:

Satellite Faculty Composition

The Illinois Satellite faculty members are all internationally recognized researchers in their respective areas of expertise. They were specifically invited to complement the I²CNER research activities at Kyushu, and they are continually re-assessed based upon their relevance to the overall I²CNER vision and roadmap. As of March 31, 2015, there are 8 Satellite Faculty and 1 WPI Principal Investigator participating at the Illinois Satellite. 1 member of I²CNER's External Advisory Committee (EAC), Dr. Robert Finley, is from the University of Illinois. In addition, there are several former Satellite Faculty members who are still working with I²CNER in some capacity: 1) Prof. Ian Robertson, Dean of the College of Engineering, University of Wisconsin-Madison, 2) Prof. Ken Christensen, University of Notre Dame, and 3) Prof. Lane Martin, University of California, Berkeley.

Chancellor Wise's Visit to Japan

In an effort to further strengthen the relationship between Kyushu University and the University of Illinois, the UIUC Chancellor, Phyllis Wise, visited Kyushu University in November 2014. During the Chancellor's visit, she had meetings with several important Kyushu University administrators, and she extended an open invitation to those administrators to travel to the Urbana-Champaign campus to further promote the ties between our universities. KU Executive Vice President in Charge of Research and Industrial Collaboration, Prof. Masato Wakayama, plans to visit UIUC May 21-22, 2015.

Revised Satellite Agreement

Upon I²CNER's renewal for a second term, Kyushu University administrators began working with administrators at the University of Illinois at Urbana-Champaign to update the “Satellite Agreement,” which will expire in November 2015. Though discussions and negotiations for the agreement are ongoing, some new details that will be addressed by the agreement include specific terms on Intellectual Property, provisions for the establishment of individual research agreements, etc.

Agreement on Academic Cooperation

As part of the ongoing effort to promote mutual understanding and strengthen the relationship between Kyushu University and the University of Illinois at Urbana-Champaign, an “Agreement on Academic Cooperation” between the two universities was signed on May 26, 2014. The specific purpose of this agreement is to develop scientific, academic, and educational cooperation on the basis of equality and reciprocity.

Memorandum of Understanding on Intellectual Property

A “Memorandum of Understanding” between Kyushu University and the University of Illinois at Urbana-Champaign was negotiated cooperatively by KU’s Industry-University-Government Collaboration Management Center (IMAQ) and UIUC’s Office of Technology Management (OTM) to specify ownership and sharing of costs and revenue for the protection and commercialization of Intellectual Property created at the I^{2}CNER Satellite. This MOU was signed on March 26, 2015. One of the stipulations of this MOU was that further clarification would be specified in the revised “Satellite Agreement,” which will be signed in FY 2015. Please see above for more details.

Undergraduate Exchange Agreement

A “Student Exchange Program Agreement” between Kyushu University and the University of Illinois at Urbana-Champaign was signed on October 24, 2014. The purpose of the agreement is to institutionalize the process of student exchange and to promote “traffic” across the Pacific between the Kyushu University School/Graduate School of Engineering and the UIUC College of Engineering.

2nd Group of Undergraduate Exchange Students hosted at Illinois

From February 23-March 25, 2015, 6 Kyushu University undergraduate students from the Faculty of Engineering traveled to the University of Illinois at Urbana-Champaign as part of the I^{2}CNER Undergraduate Exchange program. The students observed and assisted with research in UIUC laboratories under the supervision of Satellite Faculty and graduate students, participated in group meetings, completed weekly “check-ins” with the Director of the Satellite, took tours of 2 local engineering companies, and interacted heavily with the Center for East Asian and Pacific Studies (CEAPS) to enhance their cultural experience of the university.

Faculty Promotion Process

I^{2}CNER’s promotion process is based upon the process used at Illinois, which maintains the high standards that are typical at top US universities. The process involves a confidential assessment by world-leading scientists from the international community in the candidate’s area of expertise, and is carried out by a promotion committee involving senior faculty members from both KU and Illinois. Following this process, 2 of I^{2}CNER’s young researchers were promoted in FY 2014 (1 from Postdoctoral Researcher to Assistant Professor and 1 from Assistant Professor to Associate Professor). In addition, 2 more young researchers will be promoted as of April 1, 2015 (1 from Postdoctoral Researcher to Assistant Professor and 1 from Assistant Professor to Associate Professor).

Satellite Advisory Committee

The I^{2}CNER Satellite Advisory Committee has been in place since the inception of the Institute. With the transfer of the I^{2}CNER Satellite Associate Director, Prof. Ken Christensen, to the University of Notre Dame, in FY 2014, the Satellite Advisory Committee has assumed a more prominent role. The committee members are Professors Ian Robertson, Andrew Gewirth, and Ken Christensen. This committee advises the Director on all science issues at the I^{2}CNER Satellite, including, but not limited to proposal reviews, project reviews, and consultation on Satellite research directions and general research issues.

Fostering Young Researchers and Advancing their Career Paths

Evaluation Letters to Young Investigators

The research progress of all young faculty members is reviewed by the Director, Associate Directors, and the corresponding Division Lead PI on an annual basis, including an individual face-to-face interview with the Director and Associate Directors in the month of February. Following these Annual Interviews and Assessments of Young Faculty and post-docs, feedback is provided to the young investigators in the form of a specific, individualized assessment and evaluation letter from the Director.

Distribution of Funding to Young Faculty

Having an overall view of the progress and activities of the full time I^{2}CNER faculty and researchers, the Director has at his disposal the "I^{2}CNER Competitive Funding" and the "Director's Discretionary Funding," which are both intended to foster and advance interdisciplinary research. Competitive funding is allocated to those faculty members who are productive, and whose achievements (including papers, awards, winning external research funds, etc.) are relevant to I^{2}CNER's fusion research. The productivity of those faculty who receive competitive funding is assessed each year, and the funding is reallocated based upon this assessment. In addition, we also allocate fundamental Start-up Research Funding to young faculty members in order to support their research programs, with specific instructions that the funds should be used to advance interdisciplinary research.

SRA Program

I^{2}CNER's "Super Research Assistants (SRA)" Program is intended to recruit and support excellent graduate students to carry out PhD thesis work under the supervision of our WPI assistant, associate, and full professors within the various divisions of the Institute. All SRAs are required to make presentations in English at the Institute Interest Seminar Series, submit progress reports, and give an additional presentation before the Institute's SRA Selection Committee for the renewal of their SRA status. The quality of I^{2}CNER SRAs is demonstrated by the fact that our former SRAs have been hired as JSPS fellows (i.e. Research Fellowship for Young Scientists: doctoral course students). I^{2}CNER employed a total of 8 SRAs in FY 2014.

Skill Building Seminars

The Institute holds special seminars for young researchers on a regular basis to help them improve their proposal-writing skills. By way of example, the 3rd KAKENHI Seminar was held by Prof. Michihisa Koyama (Energy Analysis Division) and Prof. Shigenori Fujikawa (CO_2 Capture and Utilization Division) on September 8, 2014, and 23 of I^{2}CNER's young researchers attended.

Post-I^{2}CNER Appointments of Young Researchers

Throughout its first 5-year term, many of I^{2}CNER's young researchers have leveraged their I^{2}CNER appointments to advance their careers. Some examples are:

- Dr. Yuki Naganawa (Postdoctoral Researcher) accepted a position as an Assistant Professor at Nagoya University, Japan.
- Dr. Le Zhang (Postdoctoral Researcher) accepted a position as a Postdoctoral Researcher at Eindhoven University of Technology, Holland.
- Dr. Seiichiro Kimura (Postdoctoral Researcher) accepted a position as an Associate of the Matsushita Institute of Government and Management, Japan.
- Dr. Ryota Watanabe (Postdoctoral Researcher) accepted a position as a Researcher at the National Institute of Advanced Industrial Science and Technology (AIST), Japan.
- Dr. Shuai Wang (Postdoctoral Researcher) accepted a position as a Postdoctoral Researcher at the University of Wisconsin-Madison, USA.
- Dr. Xuping Li (Postdoctoral Researcher) accepted a position as an Air Resources Engineer at the State of California Air Resources Board (CARB), USA.
- Prof. Maki Matsuka (Assistant Professor) accepted a position as a Researcher at the National Institute of Advanced Industrial Science and Technology (AIST), Japan.
- Prof. Sean Bishop (Assistant Professor) accepted a position as a Research Associate at the Massachusetts Institute of Technology (MIT).
- Prof. Nobuo Nakada (Assistant Professor) accepted a position as an Associate Professor at the Tokyo Institute of Technology, Japan.

Visiting Students

In order to facilitate active exchange of students between Kyushu University and the University of Illinois (I^{2}CNER Satellite Institute), and other collaborating institutions overseas, the Institute accepts short-term students from overseas as "Visiting Students" at Kyushu University. 2 visiting students from UIUC were hosted in FY 2014.

International Symposia

- On an annual basis, I^{2}CNER holds a symposium addressing the current scientific state-of-the-art in its thematic research areas (divisions). The objective of this series of international symposia is to identify what I^{2}CNER researchers see as the major roadblocks, challenges, and opportunities in those fields, to demonstrate how the Institute's efforts are addressing these, and to show where the Institute's research activities lie in terms of excellence, successful fusion, and interdisciplinary impact relative to the spectrum of research being carried out today in the global scientific community. Each year, the symposium is followed by more specific workshops organized by each division. These workshops are brainstorming fora which provide opportunities to identify strengths and weaknesses in our research portfolio, and explore how we might best accomplish critical growth in scientific breadth of the thematic research areas. In FY 2014, the "I^{2}CNER Annual Symposium 2015: Fuel Generation and Use for the 21st Century" was held on February 2, 2015 and was attended by 141 scientists. Holding with the I^{2}CNER tradition, follow-up workshops were hosted by each division as part of the "I^{2}CNER International Workshop" on February 4 and 5, 2015. The topics of these 9 workshops included the hydrogen economy, hydrogen production by photocatalytic water splitting, sustainable material conversion systems, innovative CO_2 capture, CO_2 geological storage, hydrogen materials interactions (fatigue and fracture, and tribology), and thermal issues for hydrogen and related energy systems.

- The hosting of the Tokyo Symposium, which is sponsored by the U.S. Embassy in order to bring I^{2}CNER research activities to the attention of the energy stakeholders in the capital of Japan and the international community, is another growing I^{2}CNER tradition. So far, two symposia were hosted in 2012 and 2014, both with the presence of the US Ambassador to Japan and high-ranking government officials from MEXT, DOE, and the White House. The stated objective of the 2014 symposium was to show how merging Japan and the US academic and research cultures is impacting and transforming multidisciplinary international research and academic infrastructures, and explore what can be done to improve, enhance, and accelerate the transition of our research to impactful energy solutions.

- 4 WPI institutes (AIMR, iCeMS, MANA and I^{2}CNER) organized a workshop at the E-MRS (European Materials Research Society) Spring Meeting in Lille, France in May 2014. Director Sofronis and Professors Sakai and Adachi gave presentations at the workshop.

4. <u>Implementing organizational reforms</u>

* If innovated system reforms generated by the center have had a ripple effect on other departments of the host institutions or on other research institutions, clearly describe in what ways.

○ *I^{2}CNER's Merit-based Salary System/ KU's New Merit-based Annual Salary System*

Compensation considerations are based upon a special agreement between I^{2}CNER and Kyushu University entitled "Regulations on Special Measures on the Hiring of National University Corporation Kyushu University International Institute for Carbon-Neutral Energy Research Employees." As a result of this special agreement, I^{2}CNER follows a special merit-based salary system which deviates from the established salary ranges. Upon KU's review of the effectiveness of this system in I^{2}CNER, it was determined that the university should adopt this system across all units in order to make KU an attractive place for young scientists to initiate their career, and for senior scientists to expand their research programs. Kyushu University's new merit-based annual salary system for faculty members is intended to promote revitalization by securing diverse, international, and competent personnel. As of April 1, 2015, 6 Kyushu University faculty will be paid within this system. Kyushu University's long-term goal is to pay approximately 20% of its faculty within this system.

○ *Cross-Appointment Employment System*

In view of the successful model of Director Sofronis' cross-appointment case, which was the first ever at Kyushu University, KU institutionalized a cross-appointment employment system in March 2015. Though there are no cross appointments through the system yet since it is brand new, the Kyushu University Administration is working to promote/encourage new appointments through this system, which may include researchers from the private sector (industry) within and outside Japan, and other universities and institutes, both foreign and domestic. The KU Administration views this system as an excellent way to identify and leverage resources for hiring elite young faculty at Kyushu University. By way of example, a possible cross appointment case is being explored between the Institute of Mathematics for Industry (IMI) and an Australian institution. In addition, the Kyushu University Administration plans to utilize this system in the hiring of new faculty for its new undergraduate school, which will fall within the framework of the Super Global University (Top Global University) initiative.

- *Intra-University Faculty Transfer System*
  Kyushu University's "Intra-University Faculty Transfer System" was designed to enable flexibility in allocating faculty within the University for the purpose of improving the standards of education and research conducted at KU. Utilizing this personnel-system reform, 9 senior-level Kyushu faculty have been transferred to I^2CNER and serve as the core Kyushu-based PIs of I^2CNER. These tenured faculty can return to their original departments after they have spent a reasonable amount of time in I^2CNER. After having utilized this system for the past 2 years, the current Kyushu University Administration is working together with I^2CNER to assess the effectiveness of the system and to explore ways in which the system could be improved. By way of example, discussions have been initiated between the KU Administration, I^2CNER, and other academic units of KU to consider whether or not the transfers may better serve Kyushu University and the WPI vision if they are made permanent.

- *Travel Expenses for Inviting Researchers from Overseas*
  Under authorization of the Kyushu University Administration, when inviting renowned researchers from overseas, I^2CNER implemented a unique practice of paying increased per diem rates to offset higher travel expenses for more prestigious/internationally visible researchers (i.e. in special circumstances) in order to ensure that travel costs did not become a barrier to their visiting Kyushu University. The idea behind this practice is to increase the overall international visibility of I^2CNER/Kyushu University by attracting the world's best researchers to visit to give seminar presentations, interact with our researchers, etc. Due to the success of this practice in I^2CNER, the Kyushu University Administration has authorized this practice in other units of KU, as well. By way of example, the Ultramicroscopy Research Center, the Graduate School of Integrated Sciences for Global Society, and the Faculty of Information Science and Electrical Engineering have all issued increased per diem payments to world-renowned visiting researchers.

- *I^2CNER Faculty Involvement with Teaching*
  I^2CNER faculty are involved with teaching. Three (3) new "Education and Research Fields," which Kyushu University has established in the School and Graduate School of Engineering, and the Department of Automotive Science of the Graduate School of Integrated Frontier Sciences, are all engaged in research areas which overlap with those of I^2CNER. The university has already ensured that the Institute's full-time faculty members can remain involved with both the teaching and supervision of students within the university in these schools. In fact, KU values this involvement and views it as essential to the revitalization of its programs because it brings into the classroom faculty with international experiences with cutting-edge research. The load will be flexible in order to help maintain the highest possible standards of performance, both for their research and teaching obligations. I^2CNER's young faculty have already begun teaching joint courses on energy. These courses are part of the globalization program of KU, such as the former GLOBAL 30 and the recent Top Global University (TGU) Program of MEXT. As such, the average teaching load for I^2CNER's young faculty is low (co-teaching of a single course per academic term). In addition, KU is planning to establish an International Liberal Arts and Sciences College (this is a tentative name and it is a new undergraduate school) within the coming 4 years in the framework of the TGU program. This college will encompass both physical and social sciences. We envision that I^2CNER's young faculty will help the educational mission of the new college by offering science and technology courses in their relevant fields, again, in a way that balances research and teaching obligations. Since, according to President Kubo's vision, 10-15 of I^2CNER's PIs will come from other units of KU or industry, either through the Intra-University Transfer System or cross-appointments, it is our vision that these tenured PIs in I^2CNER will supervise the graduate students they bring with them from their home departments jointly with other I^2CNER faculty. For the faculty of Kyushu University contributing to the project through the transfer system or cross appointments, the university will work with the home departments to provide the support needed for the employment of

substitutes for their educational mission. The I^2CNER faculty's involvement in teaching will be used as a model for other, similar units of Kyushu University.

- *I^2CNER's Role in Kyushu University's Internationalization Initiative*
  Kyushu University is implementing a project for internationalization of research and education throughout the University. As a part of this plan, efforts have been made in collaboration with the International Affairs Division of Kyushu University to introduce undergraduate and postgraduate degree programs in English; to increase the number of international students and excellent lecturers; to prepare internal documents and the university webpage in English; to assist students and staff members to improve their English language skills; and to establish international student and researcher support centers at every campus in order to further accelerate the establishment of international education and research environments. In this regard, I^2CNER provides an unparalleled opportunity for many permanent Kyushu University employees, especially those who serve in the Institute's Administrative Office, to strengthen their English language skills, which can then be used in subsequent posts at KU. By way of example, a former I^2CNER Associate Administrative Director was promoted to the Head of the International Student Exchange Division of the International Affairs Department as of September 1, 2014.

- *Revision of KU Systems*
  In addition, Kyushu University works in cooperation with I^2CNER for flexible implementation, adjustment, and modification of the university's internal systems, upon the requests from the Institute Director, in order to ensure smooth management of the Institute. For example, the Executive Vice President in charge of Research is currently working with the I^2CNER Director and other academic units of Kyushu to explore cross appointments, improvement of the intra-university faculty transfer system, and identify ways for I^2CNER to leverage the existing Kyushu University Joint Research Department System.

5. Efforts to secure the center's future development over the mid- to long term

* Please address the following items, which are essential to mid- to long-term center development:
- Future Prospects with regard to the research plan, research organization and PI composition; prospects for the fostering and securing of next-generation researchers
- Prospects for securing resources such as permanent positions and revenues; plan and/or implementation for defining the center's role and/or positioning the center within the host institution's institutional structure
- Measures to sustain the center as a world premier international research center after program funding ends (including measures of support by the host institution)

- *President Kubo's Vision*
  I^2CNER embarks upon its second term as a permanent unit of KU. According to President Kubo's vision, there are going to be (10) tenured PIs organically in I^2CNER. The rest of the 10-15 PI positions in I^2CNER (out of the 20-25) will come from either: a) other units of KU through the Intra-University Transfer System (this means that those tenured faculty can return to their original departments after they have spent a reasonable amount of time in I^2CNER), b) through cross-appointments between I^2CNER and other units of KU, e.g. economics, sciences, mathematics, life sciences, etc., or c) through cross-appointments between I^2CNER and its international partner institutes and industry. In addition, the vision is that 3 to 4 PIs amongst the 10 tenured faculty will be non-Japanese. In order to support the recruitment of such distinguished researchers as tenured I^2CNER PIs from abroad, Kyushu University has recently introduced in its Education and Research Council the new Merit-based Annual Salary System, which allows for these foreign faculty to be compensated with a competitive salary, according to international standards. Lastly, apart from the PI categories (a), (b), and (c) above, following the Institute's policy on Faculty Fellows, I^2CNER will host Faculty Fellows at the PI level.

- *University Reform Revitalization Program*
  Kyushu University implements the "University Reform Revitalization (URR) Program" in order to encourage individual units of the University to actively review their structure and promote reform in order to revitalize the University. In line with this policy and the President's Vision for tenured PIs in I^2CNER as described above, I^2CNER competes for tenured positions through this program by annual proposal submissions, and will make continued efforts to secure additional tenured positions. As of April 1, 2015, I^2CNER has a total of 2 tenured full-professor and 7 tenured associate professor

positions, of which, 2 positions will be used to hire foreign PIs, as required by the KU Administration. International recruitment efforts are ongoing.

- *Kyushu University Administration Support of the Diversification of I^2CNER Faculty*
  Kyushu University will help the Director to diversify the population of I^2CNER PIs and expertise in areas such as mathematics, economics, social and life sciences, and computational science. Faculty appointments in I^2CNER from other KU units will be viewed as prestigious positions in Kyushu University.

- *Computational Sciences and Mathematics within I^2CNER*
  Already, efforts have been initiated to expand I^2CNER's current research plans to include computational sciences and mathematics. This is to be accomplished through exploratory workshops.

- *I^2CNER Synergy with Kyushu University*
  Under the advisement of the KU President, meetings are underway with other Kyushu University units and Executive Vice Presidents to discuss the expansion of I^2CNER's engagement with Kyushu University. The idea is to expand the research platform of I^2CNER to leverage Kyushu University's resources beyond those of the Faculty of Engineering. By way of example, I^2CNER is in discussions with the Executive Vice President for International Programs about leading Kyushu University's participation in the RENKEI program. The KU President personally facilitates and oversees the discussions between I^2CNER and other KU units about the personnel structure and personnel allocation framework within I^2CNER, in consideration of the Director's policy and expectations. At the request of the President, the Executive Vice President in charge of Research will make necessary arrangements within the university/nurture I^2CNER's relationships with other KU units. Specifically, by encouraging permanent faculty transfers and cross-appointments, the President has provided a framework in which I^2CNER can develop a synergistic relationship with other Kyushu units. All of this is done in support of the Director's efforts to execute the WPI vision for the university.

- *Leveraging I^2CNER infrastructure to compete for research funding*
  With regard to securing revenue, I^2CNER researchers leverage the established infrastructure and research culture of the Institute to aggressively pursue funding. By way of example, efforts are currently underway through the Core-to-Core international program of JSPS and the PIRE program of NSF. In addition, I^2CNER PIs are pursuing large funding for their research efforts in the form of research centers. By way of example, Prof. Ogo directs the Center for Small Molecule Energy (CSME) and Prof. Horita has proposed the "International Research Center of Giant Straining for Advanced Materials (IRC-GSAM). As an Institute, I^2CNER will leverage the initiatives of the government of Japan for globalization of the national universities. Due to its linkage with the University of Illinois, I^2CNER, along with KU, is in a unique position to compete for resources in these government initiatives. Additional resources are expected to come from technology transfer or patent sales and corporation-supported non-tenured faculty members whose research is impactful to the corporation's operations (e.g. Air Liquide's support of Prof. Alex Staykov).

- *Kyushu University's Mid-term Plan*
  I^2CNER is at the center of Kyushu University's (KU) mid-term plan, which specifies that KU will "promote leading-edge research related to the carbon-neutral energy research domain in collaboration with the University of Illinois, which is conducted at the International Institute for Carbon-Neutral Energy Research (I^2CNER). I^2CNER is one of the research centers funded by the "World Premier International Research Center Initiative (WPI)" of MEXT and possesses the strength and unique characteristics of Kyushu University." Also, in its third-period mid-term goal and plans, KU is considering developing an energy-related plan centered on I^2CNER.

- *I^2CNER Research Hub*
  In order to continue developing a research environment befitting a top world-level research institute, and to promote collaboration and fusion research, I^2CNER Building 2 was completed at the end of February 2015, following the completion of I^2CNER Building 1 in FY 2012. Both buildings are designed to promote interdisciplinary research in an "under one roof" spirit, and are home to several common laboratories which are available for use by any I^2CNER researcher. The I^2CNER Buildings are located at the heart of the Center Zone on the Ito Campus of Kyushu University, which is being developed rapidly into the university's new research hub/industry-academia zone. In April 2014, the university's administration moved into the newly-built Shiiki Hall, which is adjacent to the

I^2CNER Buildings. KU's Center of Innovation (COI) project, the Center for Co-Evolutional Social Systems (CESS), is also in the same vicinity.

- *I^2CNER's Permanent Position within Kyushu University*
  Effective April 1, 2013, with the revision of the Regulations of Kyushu University, which are the most significant among its rules and regulations, I^2CNER's position is clearly defined as a permanent Research Institute of Kyushu University without regard to the length of the WPI Program. In addition, the revised General Regulations of Faculty Councils and the Regulations of I^2CNER enable the Institute to have a Faculty Council within the institution in light of the Director's top-down decision making system, which is the intent of the WPI Program. These revisions make I^2CNER's Faculty Council substantially different from conventional Faculty Councils. This unconventional approach not only serves as a catalyst for improving the members' mindset, but also as a challenge to impact the very concept of the faculty council system in Japan.

- *Options for long-term funding of I^2CNER*
  With regard to additional funding sources for the operation of I^2CNER, the following financial measures are under consideration:

  1. In addition to the KU management expense grants, which are spent for the operation of I^2CNER, external funding acquired by the core researchers will be allotted to management, personnel, research, and any other expenditures of their own research activities.
  2. Hiring of corporation-supported non-tenured faculty members whose research is impactful to the corporation's operations (an example is the former employment arrangement of Prof. Kubota through an Air Liquide grant).
  3. Resources from technology transfer or patent sales. The KU office for technology transfer (IMAQ) is expected to play an active role in this development.
  4. Foundations associated with KU could contribute to I^2CNER's sustainability. Example cases within KU are the Inamori Frontier Research Center, which is supported by Kyocera, and the research support provided by the Gas Association of Japan to the Faculty of Engineering.
  5. Leverage the initiatives of the Government of Japan for globalization of the National Universities. Thanks to its linkage with the University of Illinois, I^2CNER, along with KU, is in a unique position to utilize these government initiatives for resources and future expansion.
  6. I^2CNER will promote/advance the "open innovation process," and aggressively pursue relationships with industry and government programs to identify mission-oriented basic science that will support technology implementation in industry.

- *Maintaining the International Culture of I^2CNER*
  To attract leading researchers from overseas universities and research institutes to I^2CNER, new initiatives, such as I^2CNER's Faculty Fellows Program, and KU's "Cross-Appoint System" (established in March 2015) will be utilized. More active engagement and interactions between KU and Illinois researchers will be promoted through mutual PI sabbaticals, etc. based on the Agreement on Academic Cooperation between the two universities (signed in FY2014). The Agreement on Student Exchange, which was also signed in FY2014, will help further promote student exchange between Kyushu and Illinois, and may lead to the development of a "Joint-Degree Program," etc.

- *I^2CNER-Industry Collaboration*
  Kyushu University plans to further promote I^2CNER's collaboration with industry through its unique "Joint Research Department System," which has been implemented successfully in other KU units, such as the Faculty of Engineering, the Faculty of Information Science and Engineering, the Center for Advanced Medical Innovation, the Faculty of Agriculture, the Institute of Mathematics for Industry, etc. The Kyushu University Administration is working with the I^2CNER Director to establish such a Joint Research Department within I^2CNER in the near future. In addition, strong cooperation between the Industry-University- Government Collaboration Management Center of Kyushu University (IMAQ) and the Office of Technology Management (OTM) of the University of Illinois has already started. IMAQ and OTM signed an agreement on IP Management on March 26, 2015. Visits amongst the two offices are planned for discussions on both national and international technology transfer.

- *Support from KU's Office for Strategic Research Planning*
  The Office for Strategic Research Planning and other related offices of Kyushu University will continue to proactively support researchers in their efforts to secure large competitive research grants. Such assistance involves information gathering and thorough advice on grant applications. By way of example, Prof. Horita has applied for the "International Research Center of Giant Straining for Advanced Materials (IRC-GSAM). In addition, the Office will assist I^2CNER in its efforts to compete for research funds from the local government and industries in related areas.

- *I^2CNER Director's Authority and Access to the KU President*
  Regular meetings will be held between the Director and the Executive Vice President in charge of Research and Industry Collaboration. Advice and counsel from the President will be given as needed. With regard to matters relating to the promotion of university-industry collaboration, the Executive Vice President in charge of Research and Industry Collaboration will provide the Director with necessary support and advice. I^2CNER is in line with the mid-term goal and plans of Kyushu University, and organized directly under the President of Kyushu University. The Institute Director, Prof. Sofronis, has direct access to the Office of the President and the Office of the Executive Vice President in charge of Research and Industry Collaboration. Support to the Institute Director from the University President, and from all individual departments of Kyushu University, will continue to be guaranteed. In addition, the Executive Vice President in Charge of Research and Industry Collaboration is working to further strengthen awareness and support of I^2CNER amongst the other Vice Presidents. The decision-making system of the Institute has been set so that the Director is solely responsible for making decisions regarding the planning and conduct of the research activities, the formation and composition of the research program areas or divisions, potential division reorganization and redirection of research efforts in response to the feedback from the annual site visit reviews of the Institute, the recruitment of postdocs and faculty, the establishment of international collaborations and interactions with top research Institutions, the administration of the peer evaluation process of the Institute's research output, and budget implementation, the idea being that the Director's authority will affect future organizational reforms, developments, etc.

- *Kyushu University Administration Support of I^2CNER Administrative Office*
  As part of the university's continued efforts to strengthen the administrative support for I^2CNER, a Head of Administration, which is a management-level position, was assigned to the Administrative Office in FY2014. I^2CNER is the only permanent research institute at Kyushu University that has its own support office, making this the first such assignment ever made at the university.

- *I^2CNER as a Model for Kyushu University Internationalization*
  Kyushu University promotes the concept of this Institute as the model project for internationalization of research and education in the University, and applies the concept to the entire University body, with the aim of transforming Kyushu University's academic culture so that it exemplifies the WPI vision for international reputation, training of young scientists in an international environment, advancing knowledge through an open research platform, and attracting scientists and students from around the globe.

6. Others

* In addition to the above 1-5 evaluation items, only if there is anything else that deserves mention regarding the center project's progress, please note it.

Internal Programs Review Committee (IPRC)

The Internal Programs Review Committee (IPRC) is an important standing committee of the Institute which is called by the Director whenever necessary to review individual programs within the Institute. The members of the IPRC and the Chair of the Committee are appointed by the Director. Once the review(s) are complete, the IPRC provides the Director with a written advisory report. The final decision about what action to take regarding any individual research program is the responsibility of the Director. In FY 2015, the composition of our Internal Programs Review Committee (IPRC) will be revisited in order to make it more efficient (meetings involving discussion and debate), so as to enable it to reach more concrete and evaluative conclusions (e.g. more critical assessments of underperforming research efforts).

Chief Science Advisor

Prof. Ian Robertson, Dean of Engineering at the University of Wisconsin-Madison, not only serves as a Principal Investigator of the Hydrogen Materials Compatibility Division, a member of the IPRC, and a member of the Satellite Advisory Committee, but also as the Chief Science Advisor to the Director in order to further strengthen the management of the Institute in relation to its research activities.

FY 2014 Recruitment Campaigns

In FY 2014, the Institute ran 1 open recruitment campaign for foreign PIs from which we received 12 applications and made 0 hires. Similarly, the Institute ran 1 open recruitment campaign for faculty positions from which we received 3 applications and made 0 hires. In the area of postdoc recruitment, we ran 2 open recruitment campaigns resulting in a total of 29 applications and hired 1 foreign researcher. In addition, we ran 2 recruitment campaigns specifically for researchers for the Energy Analysis Division which resulted in 3 applications for faculty positions and 10 applications for postdoc positions, but 0 hires were made.

7. Center's response to interim evaluation

Transcribe each item from the "7. Actions required and recommendations" section and note how the center has responded to them. However, if you have already provided this information, please indicate where in the report.

1) *The current composition of researchers is limited to a few areas of engineering, lacking theorists, mathematicians, environmental specialists and social scientists. Diversification of PIs and their expertise is indispensable if I^2CNER wants to challenge mid- to long-term disruptive technology targets*.

   I^2CNER's status in KU President Kubo's vision, specifically, his plan for I^2CNER's interaction with other units of Kyushu, will help transition I^2CNER into a center that involves additional key components, such as technology forecasting, social return on investment, science communication with the public, mathematics, and computational science. The Director has regular meetings with the Executive Vice Presidents for Research and International Programs, and discusses precisely strategies through which the university can help I^2CNER diversify its core of PIs.

   Meetings with Prof. Sharon Hammes-Schiffer of the University of Illinois (UIUC) on computational science capabilities have already occurred. In fact, Prof. Hammes-Schiffer, a world authority on computational sciences, already began working with I^2CNER. A workshop which focuses on and explores computational sciences in carbon neutral energy, and which will involve a few relevant, well-regarded academic and industrial research partners, is planned for FY 2015. This summer, I^2CNER PIs Christensen and Tsuji will participate and give a presentation in the meeting of the Mathematics for Industry Study Group, which will be held from July 29 to August 4 at Kyushu University and the University of Tokyo. The idea is to work in collaboration with the Executive Vice President for Research of KU to explore interactions with the mathematics community which hopefully will result in a workshop on applied math for energy. Another area under consideration is related to modeling of the electric grid, which is essential for understanding how renewable energy can be integrated with the network. Prof. Fujii from the University of Tokyo has been appointed as a WPI Visiting Professor to help with exploratory discussions on subject.

   Regarding the recommendation on social science, the EAD is aggressively searching for new members, (postdocs and faculty) through continuous recruitment calls, and is also looking for an expert in social science who will assess the economic and social aspects of technology deployment. This person's objective will be to understand the deployment barriers to energy technologies as they depend upon risk and communication.

2) *Serious effort should always be made to identify next research focus and research topics with the help of EAD. Make much better use of roadmaps and concretely integrate them in the decision making vis. future research priorities*.

   The EAD has already engaged with each of the technical divisions to revisit and revise their respective roadmaps, including reconsideration, consolidation, and elimination of select projects. The roadmaps have been revised from the versions that were presented in the Interim evaluation, and whenever possible, projects' milestones were placed within a time period of 15-20 yrs. from now so that projects could finish by 2030 or 2035, rather than 2050. Lastly, benchmarks for the targets of each I^2CNER research project have been identified, and some of these benchmarks reflect our accomplishments (e.g. hydrogen activation catalysts, materials for on board hydrogen storage). All research presented in Sections 1 & 2 of this report reflects the revised/updated roadmaps as of March 31, 2015. In addition, the composition of our Internal Programs Review Committee (IPRC) will be revisited in order to make it more efficient (meetings involving discussion and debate), so as to enable it to reach more concrete and evaluative conclusions (e.g. more critical assessments of underperforming research efforts). The advice of I^2CNER's External Advisory Committee (EAC) will be taken into consideration, as well. As described above, plans are being finalized for a workshop on computation which will take place in FY 2015. The EAD is planning to investigate the feasibility of importing renewables, such as biofuels, to Japan from sources outside Japan, and the related technologies, such as integration of renewable energy to the grid. Depending on the conclusions of these efforts, I^2CNER will consider investing in the fundamental science related with these technologies.

3) *The research on CO_2 and CCS at I^2CNER is needed to redesign and enhance to reach a world top level institution.*

CO_2 Storage: Following reorganization of its personnel and research focus areas in 2012, including replacing the Division Lead PI with a younger researcher of I^2CNER, and the addition of a preeminent expert in pore scale simulations at Illinois, the CO_2 storage division has focused its efforts on becoming an international leader in the area of pore-scale flow processes central to CO_2 migration within water-saturated heterogeneous rock formations typical of Japan and many other countries considering geologic sequestration of CO_2. Evidence of this international achievement includes the development and implementation of transformational simulation and experimental techniques that have revealed new and critical physics central to CO_2 fate in rock. For example, I^2CNER is a world leader in the use of the Lattice Boltzmann Method (LBM) for simulating the flow of CO_2 and brine in digital rock models (i.e., porous simulation domains generated from scans of actual rock samples) that have now clarified, for the first time, optimal injection conditions for maximizing CO_2 capacity in the reservoir while minimizing CO_2 mobility for long-term and safe storage. Now, I^2CNER is also a world leader in laboratory experimental studies of such flow processes at reservoir conditions (i.e., very high pressures) wherein the flow physics is directly quantified. The tools that I^2CNER has developed have transformed our understanding of how CO_2 migrates through the pore space, particularly the transient nature of this migration, and highlight significant deficiencies in present modeling strategies that are often used to predict CO_2 fate in actual reservoirs. Finally, I^2CNER is making transformational advances in linking pore-scale flow physics with geological monitoring methodologies to provide a step-change in our ability to remotely monitor CO_2 once it has been injected into geologic reservoirs. By linking laboratory experiments on actual rock core with the LBM simulations mentioned above, I^2CNER has advanced the world's understanding of how rock heterogeneity can actually improve the trapping of CO_2 for safe and efficient geologic CO_2 storage while also providing a clear link between elastic wave velocities often monitored in the field with trapped CO_2 in the pore structure. Thus, post-reorganization and realignment, I^2CNER's CO_2 Storage Division has rapidly ascended to become an international authority on pore-scale flow processes central to geologic CO_2 storage, and we expect our impact and visibility to continue its rapid rise in this regard. Lastly, the CO_2 storage division researchers are deeply involved in many international collaborations on geologic CCS, including 1) a new US Department of Energy (DOE) Energy Frontiers Research Center based at the University of Illinois focused on understanding pore-scale flow processes relevant to geologic CO_2 storage in the United States, 2) the Tomakomai CCS projects in Japan, and 3) the Spitsbergen CCS effort in Norway. The involvement of I^2CNER researchers in such international collaborations further validates the international leadership of I^2CNER's CO_2 storage division, particularly noting that this division, in its current structure and associated research portfolio, is only 2+ years old.

CO_2 Capture and Utilization: The original focus of the division was to use an electrochemical method for CO_2 separation. These efforts were not very successful. In 2012, Kenis from Illinois was asked to join I^2CNER with a program focusing on conversion of CO_2 to value-added products. In the spring of 2013, the original research roadmap of the division was revised to focus on (1) CO_2 Capture, specifically separation of CO_2 using membrane-based approaches (Fujikawa, Taniguchi); and (2) CO_2

Utilization, specifically via electroreduction (Kenis in collaboration with members of the fuel cell division). The division was renamed the CO_2 Capture and Utilization Division. Dr. Fujikawa, an expert in membrane technology, became the new Lead PI of the division. Associate Professor Ikuo Taniguchi, an expert in materials synthesis, was hired to further strengthen the separation effort. *In summary, the CO_2 Capture and Utilization Division started its research from scratch in January 2013—there were only 18 months between start of the new work and the Interim Evaluation Review of I^2CNER in June 2014.* In FY 2014, Dr. Benny Freeman (University of Texas at Austin), world leader on separation processes, was added as an additional member of the division to strengthen the membrane separation efforts.

The reorganization of the division has had a positive outcome. In only 1.5 years, significant and impactful results have been obtained in both the capture and the utilization efforts. For example, a key breakthrough in developing ultrathin membranes with promising permeance and selectivity for CO_2 has been achieved. These are the world's thinnest (<30 nm), leak-free membranes that can be handled and transferred without a support material. These membranes represent a new class of materials for gas separations, but also open up new interdisciplinary research on ultrathin gas diffusion electrodes, ion conductive membranes, developments that have been rapidly emerging after the restructuring of the division. In addition, the work on the electroreduction of CO_2 is has already reached at the level of world class: the work at I^2CNER has resulted in the very best catalysts and the best gas diffusion electrodes for production of desired products such as CO, ethylene, and ethanol, with the Faradaic efficiencies (=product selectivity), current densities (rate of production), and overall energetic efficiencies obtained exceeding (at times by a factor of 10) those obtained by others in this active research field, and these world record performance levels have almost met the first benchmarks of the division's roadmap. Also note that in close collaboration with the Energy Analysis Division, members of this division have completed a techno-economic feasibility study of the membrane-based capture and the electrochemical conversion processes being pursued, with the outcome that both approaches hold promise compared to current practice and compared to alternative approaches being studied.

In summary, the requested redesign of the research efforts of the CO_2 Capture and Utilization Division took place 1.5 years ago, and has successfully created a path towards world class research, a promise which is already being fulfilled, in part.

4) *Nuclear energy should be reconsidered and preferably removed from the portfolio of future research themes*.

The EAD will continue to update I^2CNER's vision scenarios for carbon neutral energy in Japan. In these scenarios, we will recognize the possibilities for contributions from nuclear energy at various levels, including future technology developments; however, I^2CNER will not create any research efforts associated with nuclear energy.

5) *A particular effort should be made to invite world-leading top scientists who can join as foreign PIs residing at I^2CNER*.

In accord with President Kubo's vision, the long-term goal of I^2CNER is to have 3 to 4 PIs among the 10 total tenured PIs in I^2CNER be non-Japanese. Of the 3 positions which were won in the University Reform Revitalization Program in FY 2014, 2 of them will be used to hire foreign PIs, as required by the KU Administration. For the full details of I^2CNER's tenured positions, please see *President Kubo's Vision* in Section 5 above. The new Annual Salary Scheme of KU to support recruitment of distinguished foreign researchers is helpful in this recruitment effort. I^2CNER's Faculty Fellows Program will also be used to identify and help transition such foreign hires from their home institutions to KU. In February 2015, the Institute's reinvigorated recruiting campaign to hire permanent-staying foreign principal investigators began, including advertising in journals of related-societies, such as the Japan Research Career Information Network (JREC-IN) by the Japan Society of Mechanical Engineers, and the Chemical Society of Japan. This ongoing recruiting effort for foreign PIs will close on May 29, 2015. An additional campaign for postdoctoral researchers in the Energy Analysis Division and tenured faculty members at all ranks is also underway and closes on June 30, 2015. It should be noted that in our pursuit of foreign PIs, we shall never compromise our standards for I^2CNER's established research culture.

6) *A technology transfer system should be developed following many successful models internationally that can serve as examples (MIT, Stanford, ETH etc.)*.

It is the vision of President Kubo that technology transfer will be carried out through the concerted efforts of IMAQ of Kyushu University and OTM of the University of Illinois. A Memorandum of Understanding between Kyushu University and the University of Illinois at Urbana-Champaign on Intellectual Property created by these two offices has been signed. For full details on the memorandum, please see Section 3 above. IMAQ held an orientation seminar for all I^2CNER researchers on September 30, 2014. A similar meeting was held by OTM at the Illinois Satellite on February 26, 2015. Leveraging the existing resources both at Illinois and Kyushu University, IMAQ and OTM will continue to work collaboratively to create a technology transfer system for I^2CNER which may involve outreach to industry in Japan and the US. In addition, relationships between I^2CNER and industry will be fostered using KU's "Joint Research Department System." For full details, please see Section 5 above.

7) *The external advisory committee membership can be expanded in its number, expertise and nationality to seek advice for long-term strategy of I^2CNER*.

The membership of I^2CNER's External Advisory Committee was expanded and diversified in FY 2014. In October 2014, Prof. Fraser Armstrong, University of Oxford, UK, an expert on catalysis and Fellow of the Royal Society, officially accepted our invitation to serve on the EAC. In November 2014, Mr. Mark Paster, Retired Analyst from the Energy Efficiency & Renewable Energy (EERE) Office, U.S. Department of Energy (DOE), officially transitioned into an EAC member role from his former position in I^2CNER's Energy Analysis Division. Finally, Prof. Michael Celia, Princeton University, expert on CO_2 storage, specifically on pore scale behavior and upscaling to reservoir behavior, has officially accepted our invitation to join the EAC in FY 2015, effective April 12, 2015. The list of full members is as follows:

- Prof. Ronald J. Adrian (Chair), Arizona State University, USA, *National Academy of Engineering (NAE)*
- Dr. Deborah Myers (Co-Chair), Argonne National Laboratory, USA
- Dr. Robert J. Finley, Illinois State Geological Survey, USA
- Prof. Reiner Kirchheim, University of GÖttingen, Germany
- Prof. Robert McMeeking, University of California, USA, *National Academy of Engineering (NAE)*
- Dr. Kevin Ott, Retired, Los Alamos National Laboratory, USA
- Prof. Tetsuo Shoji, Tohoku University, Japan
- Prof. Fraser Armstrong, University of Oxford, UK, *Fellow of the Royal Society (FRS)*
- Mr. Mark Paster, Retired Analyst from the Energy Efficiency & Renewable Energy (EERE) Office, U.S. Department of Energy (DOE)
- Prof. Michael Celia, Princeton University, USA (as of April 12, 2015)

8) *For the sustainability of I^2CNER after ten years, efforts should be started to design the finance and seek stable funding resources*.

I^2CNER's permanent position within Kyushu University has been ensured by the KU Administration, as is reflected in President Kubo's vision (please see Section 5 for full details). According the President's vision, I^2CNER will have a core of 25 PIs, including 10 tenured PIs, with the remaining 10-15 PI positions coming from other departments of KU or from industry through various channels that the university currently has in place (e.g. cross-appointment system, etc.). Aside from the longevity which is guaranteed by the tenured positions, I^2CNER's vital role in KU will be further enhanced by the involvement of these personnel from other units of Kyushu, including the planned International Liberal Arts and Sciences College, which will naturally allow these I^2CNER PIs to step into roles (e.g. teaching) within those units that will extend beyond the I^2CNER funding period.

With regard to additional funding sources for the operation of I^2CNER, the following financial measures are under consideration:

1. In addition to the KU management expense grants, which are spent for the operation of I^2CNER, external funding acquired by the above-mentioned 25 researchers will be allotted to management, personnel, research, and any other expenditures of their own research activities.

2. Corporation-supported non-tenured faculty members whose research is impactful to the corporation’s operations (an example is the former employment arrangement of Prof. Kubota through an Air Liquide grant).

3. Resources from technology transfer or patent sales. Kyushu University plans to further promote collaboration with industry through its unique “Joint Research Department System.” Strengthening cooperation between the Industry-University- Government Collaboration Management Center of Kyushu University (IMAQ) and the Office of Technology Management (OTM) of the University of Illinois will help advance IP management and technology transfer, both nationally and internationally.

4. Foundations associated with KU could contribute to I^{2}CNER’s sustainability. Example cases within KU are the Inamori Frontier Research Center, which is supported by Kyocera, and the support for research the Gas Association of Japan provides to the Faculty of Engineering.

5. Leverage the initiatives of the Government of Japan for globalization of the National Universities. Thanks to its linkage with the University of Illinois, I^{2}CNER, along with KU, is in a unique position to utilize these government initiatives for resources and future expansion.

8. <u>Center’s response to the site-visit report</u>

Transcribe each item from the “7. Actions required and recommendations” section and note how the center has responded to them. However, if you have already provided this information, please indicate where in the report.

1) *The mindset of the PIs, all other participants and the host institutions has been much improved, but they still have to strive for excellence, prestige and status by keep a strong sense of responsibility that they are developing and running a truly international, world top-level research center to meet the expectations of the general public.*

As mentioned previously, President Kubo has formulated a specific vision for I^{2}CNER’s position and future within Kyushu University, and he intends to implement that vision along with Executive Vice President Wakayama, both through policy and progressive change of I^{2}CNER’s standing within Kyushu University. For complete details regarding the KU Administration’s efforts in this regard, please see Sections 4 & 5 above. As mentioned in Section 3, UIUC Chancellor Phyllis Wise visited Kyushu University in FY 2014 and issued an open invitation to KU Administrators to visit the UIUC campus. For more details regarding the Illinois Satellite efforts to develop a truly international research center, please see Section 3. At the Institute level, the I^{2}CNER Administration is making every effort to reinforce an I^{2}CNER-centric mindset in all of its researchers.

<u>Efforts are underway to recast the framework in which our research divisions operate in consideration of I^{2}CNER’s roadmap for a carbon-neutral energy Japan.</u> By way of example, a reconfiguration of the hydrogen production and fuel cells divisions is almost complete. This includes a change of the Lead Principal Investigator in one of the divisions.

2) *The current composition of researchers is limited to a few areas of engineering, lacking theorists, mathematicians, environmental specialists and social scientists. Diversification of PIs and their expertise is indispensable. More collaboration with basic science is needed by inviting PIs first from a closest school, the Faculty of Science of KU. Physical, material, life and computational sciences are highly recommended. This is necessary if I^{2}CNER wants to challenge mid- to long-term disruptive technology targets.*

Please see response under Section 7-1) above.

3) *Serious effort should always be made to identify next research focus and research topics with the help of EAD. Make better much use of roadmaps and concretely integrate them in the decision making vis. future research priorities.*

Please see response under Section 7-2) above.

4) *For I^{2}CNER's scenarios, it seems appropriate to include renewable energy sources imported from outside Japan. The renewable energy could be much cheaper being produced in more suitable places in the world*.

Transport of low carbon fuel from sources outside Japan, including hydrogen based on renewable energy such as wind, solar, and hydro, as well as brown coal reforming with CCS, will be carefully analyzed by the I^{2}CNER EAD, including an examination of the viability of the process. In addition, I^{2}CNER will explore required basic science breakthroughs for the development of technologies that utilize abundant renewable energy outside Japan, especially technologies that efficiently convert strong direct solar radiation in sun belts into hydrogen, including not only PV and CSP (Concentrating Solar Power) with electrolysis, but also technologies of thermal–chemical conversion and bio-chemical conversion.

In particular, biofuels are among the imported renewable energy sources from outside Japan that the EAD will analyze. For example, it is possible to gasify biomass and turn it into diesels or gasoline fuels. Biofuels could be used directly in standard or hybrid vehicles. Biofuels could be used with SOFCs to generate electricity or a combination of electricity and heat. They could be used with conventional combustion for heating homes and buildings, or to generate electricity. An important question is to identify which countries have "excess" biomass, or enough potential to produce it without compromising food production, and to determine whether those countries could export large quantities of biomass, and at what cost.

An additional project will involve the detailed analysis of the electricity grid relative to the use of new technologies and energy storage requirements. It is an uncontested realization that the future of most renewable energy solutions relies on their smooth integration into the electric grid.

5) *The research activity related to CO_2 and CCS at I^{2}CNER is not at a world top-level and should be redesigned and enhanced if it is continued*.

Please see response under Section 7-3) above.

6) *Nuclear energy should be reconsidered and preferably removed from the portfolio of future research themes*.

Please see response under Section 7-4) above.

7) *Refocus, reduce, and/or eliminate few areas that are below par and are unlikely to become internationally competitive. Replace them with high-risk, high return original projects*.

Efforts are underway to reformulate the framework under which our research on hydrogen production and fuel cells is being carried out. This includes divisional reconfigurations and Lead Principal Investigator changes.

The effort of identifying projects which are underperforming and which do not hold promise for international recognition has already started at the young researcher/faculty level. In fact, one postdoctoral researcher was terminated as of March 31, 2015. In addition, the appointments of an additional 2 assistant professors, 1 associate professor, and 1 postdoctoral researcher will be terminated as of March 31, 2016.

The Energy Analysis Division has revisited and updated the roadmaps, and any effort that does not hold promise for producing tangible results against the milestones or targets of the Division's roadmap will be reassessed. Plans will be underway pending the involvement of the IPRC.

8) *A particular effort should be made to invite world-leading top scientists who can join as foreign PIs residing at I^{2}CNER*.

Please see response under Section 7-5) above.

9) *I²CNER is recommended to develop more intimate and long-term connections or collaborations with researchers outside I²CNER to be a leader in this field. Working with leading groups in Japan in respective fields and collaboration outside US should be intensified*.

I²CNER added the Air Resources Board of the State of California (CARB) to its network of international collaborating institutions in FY 2014. Negotiations for a memorandum of understanding in the general field of hydrogen technology between I²CNER and the Helmholtz Zentrum Geesthacht (HZG) are underway. In addition, there has been communication between the Director of I²CNER, the Director of the Helmholtz Institute in Juelich, and PI Reiner Kirchheim to explore areas for possible collaboration between the two Institutes, in particular, the areas of fuel cells, hydrogen production, storage, and delivery, and materials mechanical behavior.

Very recently, in FY 2014, Professor Khellil Sefiane, Head of the Institute for Materials and Processes, University of Edinburgh, Scotland, UK, became heavily engaged with I²CNER, spending about 3 months at I²CNER. He was appointed as a WPI Professor. In FY 2015, Prof. Sefiane plans to spend four months in residence at Kyushu through a cross appointment in the "Progress 100" Program. The possibility of a future/continuing cross-appointment for Prof. Sefiane will be explored in FY 2015.

We appointed Dr. Kurosawa from the Institute of Applied Energy as a WPI Visiting Professor to work with the EAD on the MARKAL-TIMES energy model developed by the International Energy Agency to analyze feasibility and impact of energy scenarios. We also appointed Prof. Fujii from the University of Tokyo as a WPI Visiting Professor to help the EAD with the analysis of the integration of renewables with the grid. In FY 2015, Dr. K. Hirose from TOYOTA Motor Corporation will be appointed as a WPI Visiting Professor to help the EAD with assessing and analyzing hurdles or opportunities to achieve a carbon-neutral energy society in Japan with regard to the needs and deployment of a hydrogen infrastructure for the production and delivery of hydrogen for fuel cell vehicles and other potential hydrogen applications.

The I²CNER Director serves on the Strategic Advisory Panel of HEmS, a research center at Oxford University whose goal is to study hydrogen in metals—from fundamentals to the design of new steels. Collaborations with other centers outside the US are in place with the Norwegian University of Science and Technology (NTNU) and SINTEF. The relevant MoU was signed on March 17, 2014.

10) *Developing a technology transfer system should be focused on in the second WPI phase. There are many successful models internationally that can serve as examples (MIT, Stanford, ETH etc.*).

Please see response under Section 7-6) above.

11) *The external advisory committee membership can be expanded in its number, expertise and nationality to seek advice for long-term strategy of I²CNER*.

Please see response under Section 7-7) above.

12) *For the sustainability of I²CNER after ten years, efforts should be started to design the finance and seek stable funding resources*.

Please see response under Section 7-8) above.

List of Center's Research Results and Main Awards

A. Refereed Papers

List only the Center's papers published in 2014. (Note: The list should be for the calendar year, not the fiscal year.)

(1) Divide the papers into two categories, A and B.

A. WPI papers

List papers whose author(s) can be identified as affiliated with the WPI program (e.g., that state the name of his/her WPI center). (Not including papers whose acknowledgements contain the names of persons affiliated with the WPI program.)

B. WPI-related papers

Among papers published in 2014, list those related to the WPI program but whose authors are not noted in the institutional affiliations as WPI affiliated. (Including papers whose acknowledgements contain the names of researchers affiliated with the WPI program.)

Note: On 14 December 2011, the Basic Research Promotion Division in MEXT's Research Promotion Bureau circulated an instruction requiring paper authors to include the name or abbreviation of their WPI center among their institutional affiliations. As some WPI-affiliated authors of papers published up to 2011 may not be aware of this requirement, their papers are treated as "WPI-related papers." From 2012, however, the authors' affiliations must be clearly noted and only category A papers will be listed.

Newly selected centers are to list papers under category C below (in addition to categories A and B above).

(2) Method of listing paper

- List only referred papers. Divide them into categories (e.g., original articles, reviews, proceedings).
- For each, write the author name(s); year of publication; journal name, volume, page(s), and article title. Any listing order may be used as long as format is the same. (The names of the center researchers do not need to be underlined.)
- If a paper has many authors (say, more than 20), all of their names do not need to be listed.
- If the papers are written in languages other than English, divide them into language categories when listing them.
- Assign a serial number to each paper to be used to identify it throughout the system.

(3) Submission of electronic data

- In addition to the above, for each paper provide a .cvs file output from the Web of Science (e.g.) or other database giving the paper's raw data including Document ID. (Note: the Document ID is assigned by paper database.)
- These files do not need to be divided into paper categories.

(4) Use in assessments

- The lists of papers will be used in assessing the state of WPI project's progress in FY 2014.
- They will be used as reference in analyzing the trends and states of research in all the WPI centers, not to evaluate individual researcher performance.
- The special characteristics of each research domain will be considered when conducting assessments.

(5) Additional documents

After all documents, including these paper listings, showing the state of research progress have been submitted, additional documents may be requested.

Order of Listing

A. WPI papers

1. Original articles
2. Review articles
3. Proceedings
4. Other English articles
5. Articles written in other than English

B. WPI-related papers

1. Original articles

2. Review articles
3. Proceedings
4. Other English articles
5. Articles written in other than English

Note: The list includes the refereed papers published in the calendar year 2014 either online or in print whichever comes first.

No.	Description
	A. WPI papers
	A.1. Original articles
1	Ju, Y.-W., Hyodo, J., Inoishi, A., Ida, S., and Ishihara, T. (2015), A dense La(Sr)Fe(Mn)$O_{3-\delta}$ nano-film anode for intermediate-temperature solid oxide fuel cells, Journal of Materials Chemistry A, 3 (7), 3586-3593
2	Noguchi, Y., Kim, H.-J., Ishino, R., Goushi, K., Adachi, C., Nakayama, Y. and Ishii, H. (2015), Charge carrier dynamics and degradation phenomena in organic light-emitting diodes doped by a thermally activated delayed fluorescence emitter, Organic Electronics: physics, materials, applications, 17, 184-191
3	Li, M., Zhang, H., Cook, S.N., Li, L., Kilner, J.A., Reaney, I.M. and Sinclair, D.C. (2015), Dramatic influence of A-site nonstoichiometry on the electrical conductivity and conduction mechanisms in the perovskite oxide $Na_{0.5}Bi_{0.5}TiO_3$, Chemistry of Materials, 27 (2), 629-634
4	Hyodo, J., Tominaga, K., Hong, J.-E., Ida, S. and Ishihara, T. (2015), Effects of three-dimensional strain on electric conductivity in au-dispersed $Pr_{1.90}Ni_{0.71}Cu_{0.24}Ga_{0.05}O_{4+\delta}$, Journal of Physical Chemistry C, 119 (1), 5-13
5	Fukuhara, L., Kosugi, K., Yamamoto, Y., Jinnai, H., Nishioka, H., Ishii, H. and Kawahara, S. (2015), FIB processing for natural rubber with nanomatrix structure, Polymer (United Kingdom), 57, 143-149
6	Li, P., He, X., Huang, T.C., White, K.L., Zhang, X., Liang, H., Nishimura, R. and Sue, H.-J. (2015), Highly effective anti-corrosion epoxy spray coatings containing self-assembled clay in smectic order, Journal of Materials Chemistry A, 3 (6), 2669-2679
7	Hirata, S., Sakai, Y., Masui, K., Tanaka, H., Lee, S.Y., Nomura, H., Nakamura, N., Yasumatsu, M., Nakanotani, H., Zhang, Q., Shizu, K., Miyazaki, H. and Adachi, C. (2015), Highly efficient blue electroluminescence based on thermally activated delayed fluorescence, Nature Materials, 14 (3), 330-336
8	Sagara, Y., Shizu, K., Tanaka, H., Miyazaki, H., Goushi, K., Kaji, H. and Adachi, C. (2015), Highly efficient thermally activated delayed fluorescence emitters with a small singlet-triplet energy gap and large oscillator strength, Chemistry Letters, 44 (3), 360-362
9	Zheng, Y.-Q., Potscavage, W.J., Zhang, J.-H., Wei, B. and Huang, R.-J. (2015), Hole transporting material 5, 10, 15-tribenzyl-5H-diindolo[3, 2-a:3', 2'-c]-carbazole for efficient optoelectronic applications as an active layer, Chinese Physics B, 24 (2), 027801
10	Inoishi, A., Matsuka, M., Sakai, T., Ju, Y.-W., Ida, S. and Ishihara, T. (2015), Lithium–Air Oxygen Shuttle Battery with a ZrO_2-Based Ion-Conducting Oxide Electrolyte, ChemPlusChem, 80 (2), 359-362
11	Takenaka, S., Mikami, D., Tanabe, E., Matsune, H. and Kishida, M. (2015), Modification of carbon nanotube surfaces with precious metal and transition metal oxide nanoparticles using thin silica layers, Applied Catalysis A: General, 492, 60-67
12	Harada, K., Oishi, T., Hamamoto, S., Kawasaki, T. and Ishihara, T. (2015), Oxygen desorption properties of Pr_6O_{11} doped with Bi and Ce for low temperature particulate matter oxidation, Applied Catalysis A: General, 492, 223-230
13	Ida, S., Kim, N., Ertekin, E., Takenaka, S. and Ishihara, T. (2015), Photocatalytic Reaction Centers in Two-Dimensional Titanium Oxide Crystals, Journal of the American Chemical Society, 137 (1), 239-244
14	Matsuno, H., Ohta, T., Shundo, A., Fukunaga, Y. and Tanaka, K. (2014), Simple surface treatment of cell-culture scaffolds with ultrafine bubble water, Langmuir, 30 (50), 15238-15243
15	Shizu, K., Tanaka, H., Uejima, M., Sato, T., Tanaka, K., Kaji, H. and Adachi, C. (2015), Strategy for designing electron donors for thermally activated delayed fluorescence emitters, Journal of Physical Chemistry C, 119 (3), 1291-1297
16	Higaki, Y., Hatae, K., Ishikawa, T., Takanohashi, T., Hayashi, J. and Takahara, A. (2014), Adsorption and desorption behavior of asphaltene on polymer-brush-immobilized surfaces, ACS Applied Materials & Interfaces, 6 (22), 20385-20389

17	Baba, T., Takizawa, T., Harada, K., Yamada, H., Ishihara, T. and Takami, A. (2015), Effect of Pr doping on catalytic properties of oxide ion conductor, Zr–Nd–O, for soot oxidation, Catalysis Today, 251, 2-6
18	White, K.L., Wong, M., Li, P., Miyamoto, M., Higaki, Y., Takahara, A. and Sue, H.-J. (2015), Interlayer structure and self-healing in suspensions of brush-stabilized nanoplatelets with smectic order, Soft Matter, 11 (5), 954-971
19	Matsumoto, K., Shundo, A., Ohno, M., Fujita, S., Saruhashi, K., Miyachi, N., Miyaji, K. and Tanaka, K. (2015), Modulation of physical properties of supramolecular hydrogels based on a hydrophobic core, Physical Chemistry Chemical Physics, 17 (3), 2192-2198
20	Shibahara, M., Watanabe, M., Goto, K., Miyazaki, T., Zhang, H., Nakayama, Y. and Shinmyozu, T. (2014), Structural properties of five- and six-layered [3.3]metacyclophanes, Tetrahedron Letters, 55 (51), 7089-7093
21	Ishihara, T., Xie, J., Shin, T.H., Ju, Y.-W., Ida, S. and Kilner, J.A. (2015), Bi doped Pr_6O_{11} as fluorite oxide cathode for all-fluorite solid oxide fuel cells, Journal of Power Sources, 275, 167-174
22	Higaki, Y., Okazaki, R., Ishikawa, T., Kikuchi, M., Ohta, N. and Takahara, A. (2014), Chain stiffness and chain conformation of poly(α-methylene-γ-butyrolactone) in dilute solutions, Polymer (United Kingdom), 55 (25), 6539-6545
23	Shibahara, M., Watanabe, M., Matsumoto, T., Goto, K. and Shinmyozu, T. (2014), Crystal structure of a four-layered [3.3](3,5)pyridinophane, Acta Crystallographica Section E: Structure Reports Online, E70, 447-450
24	Honda, K., Yamamoto, I., Morita, M., Yamaguchi, H., Arita, H., Ishige, R., Higaki, Y. and Takahara, A. (2014), Effect of α-substituents on molecular motion and wetting behaviors of poly(fluoroalkyl acrylate) thin films with short fluoroalkyl side chains, Polymer (United Kingdom), 55 (24), 6303-6308
25	Takenaka, S., Miyazaki, T., Matsune, H. and Kishida, M. (2015), Highly active and durable silica-coated Pt cathode catalysts for polymer electrolyte fuel cells: control of micropore structures in silica layers, Catalysis Science & Technology, 5 (2), 1133-1142
26	Fujimoto, H., Miyayama, T., Sanada, N. and Adachi, C. (2014), Origin of external quantum efficiency degradation in organic light-emitting diodes with a DC magnetron sputtered cathode, Journal of Vacuum Science & Technology B, 32 (6), 060603
27	Staykov, A, Watanabe, M., Ishihara, T. and Yoshizawa, K. (2014), Photoswitching of Conductance through Salicylidene Methylamine, The Journal of Physical Chemistry C, 118 (47), 27539-27548
28	Miyazaki, T., Shibahara, M., Fujishige, J., Watanabe, W., Goto, K. and Shinmyozu, T. (2014), Synthesis and Electronic and Photophysical Properties of [2.2]- and [3.3]Paracyclophane-Based Donor−Donor′−Acceptor Triads, The Journal of Organic Chemistry, 79 (23), 11440-11453
29	Yoo, S., Jun, A., Ju, Y.-W., Odkhuu, D., Hyodo, J., Jeong, H.Y., Park, N., Shin, J., Ishihara, T. and Kim, G. (2014), Development of Double-Perovskite Compounds as Cathode Materials for Low-Temperature Solid Oxide Fuel Cells, Angewandte Chemie International Edition, 53 (48), 13064-13067
30	Mayr, C., Taneda, M., Adachi, C. and Brütting, W. (2014), Different orientation of the transition dipole moments of two similar Pt(II) complexes and their potential for high efficiency organic light-emitting diodes, Organic Electronics: physics, materials, applications, 15 (11), 3031-3037
31	Guo, L., Ida, S., Daio, T., Hagiwara, H. and Ishihara, T. (2014), In-situ carbonization of soft-template to directly synthesize the crystalline mesoporous metal oxides with high surface area, New Journal of Chemistry, 38 (12), 5846-5855
32	Wachsman, E., Ishihara, T., and Kilner, J. (2014), Low-temperature solid-oxide fuel cells, MRS Bulletin, 39 (9), 773-779
33	Ishida, M., Nakahara, K., Sakashita, R., Ishizuka, T., Watanabe, M., Uno, H., Osuka, A. and Furuta, H. (2014), N-Confused phlorin: A stable dihydroporphyrin isomer containing a confused pyrrole ring, Journal of Porphyrins and Phthalocyanines, 18 (10n11), 909-918
34	Kobayashi, M., Ishihara, K. and Takahara, A. (2014), Neutron reflectivity study of the swollen structure of polyzwitterion and polyeletrolyte brushes in aqueous solution, Journal of Biomaterials Science, Polymer Edition, 25 (14-15), 1673-1686
35	Yoshida, M., Kondo, M., Nakamura, T., Sakai, K., and Masaoka, S. (2014), Three Distinct Redox States of an Oxo-Bridged Dinuclear Ruthenium Complex, Angewandte Chemie-International Edition, 53 (43), 11519-11523
36	Kawaguchi, D., Tateishi, Y., Tanaka, K. (2015), Time-resolved Fluorescence Analysis for Dye-labeled Polystyrene in Thin Films, Journal of Non-Crystalline Solids, 407, 284-287

37	Bayliss, R.D., Cook, S.N., Scanlon, D.O., Fearn, S., Cabana, J., Greaves, C., Kilner, J.A. and Skinner, S.J. (2014), Understanding the defect chemistry of alkali metal strontium silicate solid solutions: Insights from experiment and theory, Journal of Materials Chemistry A, 2 (42), 17919-17924
38	Alaydrus, M., Sakaue, M., Aspera, S.M., Wungu, T.D.K., Linh, N.H., Linh, T.P.T., Kasai, H., Ishihara, T. and Mohri, T. (2014), A DFT+U study of strain-dependent ionic migration in Sm-doped ceria, Journal of the Physical Society of Japan, 83 (9), 094707/1-094707/8
39	Fujimoto, H., Potscavage Jr., W.J., Edura, T. and Adachi, C. (2014), Analysis of electron traps formed in organic films with a sputtered cathode, Organic Electronics: physics, materials, applications, 15 (11), 2783-2791
40	Matsuka, M., Shigedomi, K. and Ishihara, T. (2014), Comparative study of propane steam reforming in vanadium based catalytic membrane reactor with nickel-based catalysts, International Journal of Hydrogen Energy, 39 (27), 14792-14799
41	Watanabe, M. and Ishihara, T. (2014), Crystal structure of (E)-2-cyano-3-(12-methyl-12H-benzo[b]phenothiazin-11-yl)acrylic acid, Acta Crystallographica Section E: Structure Reports Online, E70, o1026- o1027
42	Inoishi, A., Sakai, T., Ju, Y.-W., Ida, S., Ishihara, T. (2014), Effect of Ni/Fe ratio on the performance and stability of the Fe-air rechargeable battery using a $La_{0.9}Sr_{0.1}Ga_{0.8}Mg_{0.2}O_3$ electrolyte, International Journal of Hydrogen Energy, 39 (36), 21352-21357
43	Chen, K., Hyodo, J., O'Donnell, K.M., Rickard, W., Ishihara, T. and Jiang, S.P. (2014), Effect of volatile boron species on the electrocatalytic activity of cathodes of solid oxide fuel cells: III. $Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O_{3-\delta}$ electrodes, Journal of the Electrochemical Society, 161 (12), F1163-F1170
44	Kabe, R., Feng, X. Adachi, C. and Müllen, K. (2014), Exfoliation of graphite into graphene in polar solvents mediated by amphiphilic hexa-peri-hexabenzocoronene, Chemistry - An Asian Journal, 9 (11), 3125-3129
45	Shundo, A., Hoshino, Y., Higuchi, T., Matsumoto, Y., Penaloza Jr., D.P., Matsumoto, K., Ohno, M., Miyaji, K., Goto, M. and Tanaka, K. (2014), Facile microcapsule fabrication by spray deposition of a supramolecular hydrogel, RSC Advances, 4, 36097-36100
46	Hong, J.-E., Xie, J., Ida, S., and Ishihara, T. (2014), Increased Power Density of Solid Oxide Fuel Cells Using $LaGaO_3$ Film Prepared by Screen Printing Method with $(Ba,La)CoO_{3-\delta}$ and $Pr_{1.9}(Ni,Cu,Ga)O_{4+\delta}$ Composite Oxide Cathode, Journal of The Electrochemical Society, 161 (10), F1118- F1123
47	Téllez, H., Druce, J., Hall, A., Ishihara, T., Kilner, J. and Rockett, A. (2015), Low energy ion scattering: Surface preparation and analysis of $Cu(In,Ga)Se_2$ for photovoltaic applications, Progress in Photovoltaics: Research and Applications, 23 (10), 1219-1227
48	Hagiwara, H., Watanabe, M., Daio, T., Ida, S., and Ishihara, T. (2014), Modification Effects of meso-Hexakis(pentafluorophenyl) [26]Hexaphyrin Aggregates on the Photocatalytic Water Splitting, Chemical Communications, 50 (83), 12515-12518
49	Wang, S., Tsuruta, H., Asanuma, M. and Ishihara, T. (2015), Ni-Fe-La(Sr)Fe(Mn)O_3 as a New Active Cermet Cathode for Intermediate-Temperature CO_2 Electrolysis Using a $LaGaO_3$-Based Electrolyte, Advanced Energy Materials, 5 (2), 1401003/1-1401003/10
50	Kawano, K., Yamauchi, K. and Sakai, K. (2014), A cobalt–NHC complex as an improved catalyst for photochemical hydrogen evolution from water, Chemical Communications, 50 (69), 9872-9875
51	Ju, Y.-W., Hyodo, J., Inoishi, A., Ida, S. and Ishihara, T. (2014), $Ce(Mn,Fe)O_2$ dense film deposited on $LaGaO_3$ electrolyte for dense anode of solid oxide fuel cells, International Journal of Hydrogen Energy, 39 (35), 20777-20782
52	Ju, Y.-W., Hyodo, J., Inoishi, A., Ida, S., Tohei, T., So, Y.-G., Ikuhara, Y. and Ishihara, T. (2014), Double columnar structure with a nanogradient composite for increased oxygen diffusivity and reduction activity, Advanced Energy Materials, 4 (17), 1400783
53	Tanaka, H., Shizu, K., Nakanotani, H. and Adachi, C. (2014), Dual intramolecular charge-transfer fluorescence derived from a phenothiazine-triphenyltriazine derivative, Journal of Physical Chemistry C, 118 (29), 15985-15994
54	Wu, S.H., Nakamichi, R., Taneda, M., Zhang, Q.S. and Adachi, C. (2014), Introduction of F_4-TCNQ/MoO_3 layers for thermoelectric devices based on pentacene, Chinese Physics B, 23 (9), 098502
55	Ogawa, S., Watanabe, H., Wang, L., Jinnai, H., McCarthy, T.J. and Takahara, A. (2014), Liquid marbles supported by monodisperse poly(methylsilsesquioxane) particles, Langmuir, 30 (30), 9071-9075
56	Parent, A.R., Nakazono, T., Lin, S., Utsunomiya, S. and Sakai, K. (2014), Mechanism of Water Oxidation by Non-Heme Iron Catalysts when Driven with Sodium Periodate, Dalton Transactions, 43 (33), 12501-12513

57	Bayliss, R.D., Cook, S.N., Fearn, S., Kilner, J.A., Greaves, C. and Skinner, S.J. (2014), On the oxide ion conductivity of potassium doped strontium silicates, Energy and Environmental Science, 7 (9), 2999-3005
58	Shin, W., Yasuda, T., Hidaka, Y., Watanabe, G., Arai, R., Nasu, K., Yamaguchi, T., Murakami, W., Makita, K., and Adachi C. (2014), π-Extended Narrow-Bandgap Diketopyrrolopyrrole-Based Oligomers for Solution-Processed Inverted Organic Solar Cells, Advanced Energy Materials, 4 (17), 1400879
59	Nojima, S., Shinohara, T., Higaki, Y., Ishige, R., Ohishi, T., Kobayashi, D., Setoyama, H. and Takahara, A. (2014), Precise characterization of outermost surface of crystalline–crystalline diblock copolymer thin films using synchrotron radiation soft X-ray photoelectron spectroscopy, Polymer Journal, 46 (10), 637-640
60	Hirai, T., Osumi, S., Ogawa, H., Hayakawa, T., Takahara, A. and Tanaka, K. (2014), Precise Synthesis and Surface Wettability of a Polymer with Liquid Crystalline Side Chains, Macromolecules, 47 (15), 4901-4907
61	Okuyama, Y., Okuyama, K., Mizutani, Y., Sakai, T., Lee, Y.S. and Matsumoto, H. (2014), Proton transport properties of $La_{0.9}Sr_{0.1}Yb_{0.8}In_{0.2}O_{3-\delta}$ and its application to proton ceramic fuel cell, International Journal of Hydrogen Energy, 39 (35), 20829-20836
62	Ida, S. and Ishihara, T. (2014), Recent progress in two-dimensional oxide photocatalysts for water splitting, Journal of Physical Chemistry Letters, 5 (15), 2533-2542
63	Téllez, H., Druce, J., Ju, Y.-W., Kilner, J. and Ishihara, T. (2014), Surface chemistry evolution in $LnBaCo_2O_{5+\delta}$ double perovskites for oxygen electrodes, International Journal of Hydrogen Energy, 39 (35), 20856-20863
64	Druce, J., Téllez, H., Simrick, N., Ishihara, T. and Kilner, J. (2014), Surface composition of solid oxide electrode structures by laterally resolved low energy ion scattering (LEIS), International Journal of Hydrogen Energy, 39 (35), 20850-20855
65	Druce, J., Téllez, H., Burriel, M., Sharp, M.D., Fawcett, L.J., Cook., S.N., McPhail, D.S., Ishihara, T., Brongersma, H.H. and Kilner, J.A. (2014), Surface termination and subsurface restructuring of perovskite-based solid oxide electrode materials, Energy & Environmental Science, 7 (11), 3593-3599
66	Li, J., Zhang, Q.S., Nomura, H., Miyazaki, H. and Adachi, C (2014), Thermally activated delayed fluorescence from $^3n\pi^*$ to $^1n\pi^*$ up-conversion and its application to organic light-emitting diodes, Applied Physics Letters, 105 (1), 013301
67	Ohkuma, H., Nakagawa, T., Shizu, K., Yasuda, T. and Adachi, C. (2014), Thermally activated delayed fluorescence from a spiro-diazafluorene derivative, Chemistry Letters, 43 (7), 1017-1019
68	Linh, T.P.T., Sakaue, M., Aspera, S.M., Alaydrus, M., Wungu, T.D.K., Linh, N.H., Kasai, H., Mohri, T. and Ishihara, T. (2014), First-principles calculation on oxygen ion migration in alkaline-earth doped La_2GeO_5, Journal of Physics: Condensed Matter, 26 (25), 255503
69	Nishide, J.-I., Nakanotani, H., Hiraga, Y. and Adachi, C. (2014), High-efficiency white organic light-emitting diodes using thermally activated delayed fluorescence, Applied Physics Letters, 104 (23), 233304
70	Méhes, G., Goushi, K., Potscavage Jr., W.J. and Adachi, C. (2014), Influence of host matrix on thermally-activated delayed fluorescence: Effects on emission lifetime, photoluminescence quantum yield, and device performance, Organic Electronics: physics, materials, applications, 15 (9), 2027-2037
71	Watanabe, M., Hagiwara, H., Iribe, A., Ogata, Y., Shiomi, K., Staykov, A., Ida, S., Tanaka, K. and Ishihara, T. (2014), Spacer Effects in Metal-Free Organic Dyes for Visible-Light-Driven Dye-Sensitized Photocatalytic Hydrogen Production, Journal of Materials Chemistry A, 2 (32), 12952-12961
72	Pandey, R., Méhes, G., Kumar, A., Gupta, R.K., Adachi, C. and Pandey, D.S. (2014), Structural and mechanistic insights into an Fe^{3+}-triggered quinazoline based molecular rotor, Chemical Communications, 50 (59), 8032-8035
73	Ishige, R., Shinohara, T., White, K.L., Meskini, A., Raihane, M., Takahara, A. and Ameduri, B. (2014), Unique difference in transition temperature of two similar fluorinated side chain polymers forming hexatic smectic phase: Poly{2-(perfluorooctyl)ethyl acrylate} and Poly{2-(perfluorooctyl)ethyl vinyl ether}, Macromolecules, 47 (12), 3860-3870
74	Fujimoto, H., Edura, T., Miyayama, T., Sanada, N. and Adachi, C. (2014), Accurate measurement of dopant concentration in organic light-emitting diodes by combining high-performance liquid chromatography and TOF-SIMS, Journal of Vacuum Science & Technology B, 32 (3), 030604
75	Horinouchi, A., Yamada, N.L. and Tanaka, K. (2014), Aggregation states of polystyrene at nonsolvent interfaces, Langmuir, 30 (22), 6565-6570

76	Zhang, L., Nakanotani, H., Yoshida, K., Adachi, C. (2014), Analysis of alternating current driven electroluminescence in organic light emitting diodes: A comparative study, Organic Electronics: physics, materials, applications, 15 (8), 1815-1821
77	Lin, Y.-Z., Yeh, C.-W., Chou, P.-T., Watanabe, M., Chang, Y.-H., Chang, Y.J. and Chow, T.J. (2014), Benzo[1,2-b:4,5-b']dithiophene and benzo[1,2-b:4,5-b']difuran based organic dipolar compounds for sensitized solar cells, Dyes and Pigments, 109, 81-89
78	Takahashi, T., Shizu, K., Yasuda, T., Togashi, K. and Adachi, C. (2014), Donor-acceptor-structured 1,4-diazatriphenylene derivatives exhibiting thermally activated delayed fluorescence: Design and synthesis, photophysical properties and OLED characteristics, Science and Technology of Advanced Materials, 15 (3), 034202
79	Minn, M., Kobayashi, M., Jinnai, H., Watanabe, H. and Takahara, A. (2014), Effect of Water Swelling on the Tribological Properties of PMMA Spin-Cast Film and Brush in Aqueous Environment, Tribology Letters, 55 (1), 121-129
80	Kawano, K., Nagayoshi, K., Yamaki, T. and Adachi, C. (2014), Fabrication of high-efficiency multilayered organic light-emitting diodes by a film transfer method, Organic Electronics: physics, materials, applications, 15 (7), 1695-1701
81	Nakanotani, H., Higuchi, T., Furukawa, T., Masui, K., Morimoto, K., Numata, M., Tanaka, H., Sagara, Y., Yasuda, T. and Adachi, C. (2014), High-efficiency organic light-emitting diodes with fluorescent emitters, Nature Communications, 5, 4016
82	Lee, S.Y., Yasuda, T., Yang, Y.S., Zhang, Q. and Adachi, C. (2014), Luminous butterflies: Efficient exciton harvesting by benzophenone derivatives for full-color delayed fluorescence OLEDs, Angewandte Chemie - International Edition, 53 (25), 6402-6404
83	Shundo, A. and Tanaka, K. (2014), Mesoscopic heterogeneity in supramolecular network systems, Nihon Reoroji Gakkaishi, 42 (2), 89-95
84	Komino, T., Tanaka, H. and Adachi, C. (2014), Selectively controlled orientational order in linear-shaped thermally activated delayed fluorescent dopants, Chemistry of Materials, 26 (12), 3665-3671
85	Niwa, A., Kobayashi, T., Nagase, T., Goushi, K., Adachi, C. and Naito, H. (2014), Temperature dependence of photoluminescence properties in a thermally activated delayed fluorescence emitter, Applied Physics Letters, 104 (21), 213303
86	Shinohara, T., Higaki, Y., Hoshino, T., Masunaga, H., Ogawa, H., Okamoto, Y., Aoki, T. and Takahara, A. (2014), “Buried” nano-structure and molecular aggregation state in ordered heterojunction poly(3-hexylthiophene)-based photovoltaics, Japanese Journal of Applied Physics, 53, 5 SPEC ISSUE 1, 05FH09
87	Shibahara, M., Watanabe, M., Goto, K. and Shinmyozu, T. (2014), Four-layered [3.3]metacyclophane with ethenetetracarbonitrile, Acta Crystallographica Section E: Structure Reports Online, 70 (5), o625-o626
88	Ju, Y.-W., Jun, A., Inoishi, A., Ida, S., Lim, T.-H., Kim, G. and Ishihara, T. (2014), Growth of thin-film layered perovskite cathodes by pulsed laser deposition and their electrochemical studies in IT-SOFCs, Journal of the Electrochemical Society, 161 (6), F698-F702
89	Ishihara, T., Nakashima, R., Ooishi, Y., Hagiwara, H., Matsuka, M. and Ida, S. (2015), H_2O_2 synthesis by selective oxidation of H_2 over Pd-Au bimetallic nano colloid catalyst under addition of NaBr and H_3PO_4, Catalysis Today, 248, 35-39
90	Li, J., Nomura, H., Miyazaki, H. and Adachi, C. (2014), Highly efficient exciplex organic light-emitting diodes incorporating a heptazine derivative as an electron acceptor, Chemical Communications, 50 (46), 6174-6176
91	Staykov, A., Ooishi, Y. and Ishihara, T. (2014), Immobilizing Metal Nanoparticles on Single Wall Nanotubes. Effect of Surface Curvature, Journal of Physical Chemistry C, 118 (17), 8907-8916
92	Inoishi, A., Sakai, T., Ju, Y.W., Ida, S. and Ishihara, T. (2014), Improved cycle stability of Fe-air solid state oxide rechargeable battery using $LaGaO_3$-based oxide ion conductor, Journal of Power Sources, 262, 310-315
93	Wong, M., Ishige, R., White, K.L., Li, P., Kim, D., Krishnamoorti, R., Gunther, R., Higuchi, T., Jinnai, H., Takahara, A., Nishimura, R. and Sue, H. J. (2014), Large-scale self-assembled zirconium phosphate smectic layers via a simple spray-coating process, Nature Communications, 5, 3589
94	Jang, I.C., Ida, S. and Ishihara, T. (2014), Li utilization and cyclability of Li-O_2 rechargeable batteries incorporating a mesoporous Pd/β-MnO_2 air electrode, Electrochemistry, 82 (4), 267-272
95	Komori, T., Nakanotani, H., Yasuda, T. and Adachi, C. (2014), Light-emitting organic field-effect transistors based on highly luminescent single crystals of thiophene/phenylene co-oligomers, Journal of Materials Chemistry C, 2 (25), 4918-4921

96	Jang, I. C., Ida, S. and Ishihara, T. (2014), Surface Coating Layer on Li Metal for Increased Cycle Stability of Li-O_2 Batteries, Journal of the Electrochemical Society, 161 (5), A821-A826
97	Druce, J., Simrick, N., Ishihara, T. and Kilner, J. A. (2014), 'Imaging' LEIS of Micropatterned Solid Oxide Fuel Cell Electrodes, Nuclear Instruments and Methods in Physics Research Section B, 332, 261-265
98	Hong, J.-E., Ida, S. and Ishihara, T. (2014), Decreased sintering temperature of anode-supported solid oxide fuel cells with La-doped CeO_2 and Sr- and Mg-doped $LaGaO_3$ films by Co addition, Journal of Power Sources, 259, 282-288
99	Guo, L., Ida, S., Hagiwara, H., Daio, T. and Ishihara, T. (2014), Direct soft-templating route to crystalline mesoporous transition-metal oxides, Colloids and Surfaces A: Physicochemical and Engineering Aspects, 451 (1), 136-143
100	Zhang, Q., Li, B., Huang, S., Nomura, H., Tanaka, H. and Adachi, C. (2014), Efficient blue organic light-emitting diodes employing thermally activated delayed fluorescence, Nature Photonics, 8 (4), 326-332
101	Endo, K. and Adachi, C. (2014), Enhanced out-coupling efficiency of organic light-emitting diodes using an nanostructure imprinted by an alumina nanohole array, Applied Physics Letters, 104 (12), 1121102
102	Zhan, J., Matsuno, H., Masunaga, H., Ogawa, H. and Tanaka, K. (2014), Green solid films with tunable mechanical properties made from deoxyribonucleic acid, NPG Asia Materials, 6, e92
103	Kitamoto, K. and Sakai, K. (2014), Pigment-acceptor-catalyst triads for photochemical hydrogen evolution, Angewandte Chemie - International Edition, 53 (18), 4618-4622
104	Oda, H., Okuyama, Y., Sakai, T. and Matsumoto, H. (2014), Preparation of Nano-Structured $La_{0.6}Sr_{0.4}Co_{0.2}Fe_{0.8}O_{3-\delta}$ Cathode for Protonic Ceramic Fuel Cell by Bead-Milling Method, Materials Transactions, 55 (4), 722-727
105	Chang, Y.J., Wu, Y.-J., Chou, P.-T., Watanabe, M. and Chow, T.J. (2014), Triarylene linked spacer effect for dye-sensitized solar cells, Thin Solid Films, 558, 330-336
106	Apgar, B.A. and Martin, L.W. (2014), Understanding the competition between epitaxial strain and thermodynamics in TiO_2: Structural, morphological, and property evolution, Crystal Growth and Design, 14 (4), 1981-1988
107	Zheng, Y.-Q., Potscavage Jr., W.J., Zhang, Q.-S., Komino, T., Taneda, M. and Adachi, C. (2014), Comparison of small amounts of polycrystalline donor materials in C_{70}-based bulk heterojunction photovoltaics and optimization of dinaphthothienothiophene based photovoltaic, Organic Electronics: physics, materials, applications, 15 (4), 878-885
108	Staykov, A., Yamabe, J. and Somerday, B.P. (2014), Effect of hydrogen gas impurities on the hydrogen dissociation on iron surface, International Journal of Quantum Chemistry, 114 (10), 626-635
109	Okuyama, Y., Kozai, T., Ikeda, S., Matsuka, M., Sakai, T. and Matsumoto, H. (2014), Incorporation and conduction of proton in Sr-doped $LaMO_3$ (M=Al, Sc, In, Yb, Y), Electrochimica Acta, 125, 443-449
110	Li, Z.H., Hur, K., Sai, H., Higuchi, T., Takahara, A., Jinnai, H., Gruner, S. M. and Wiesner, U. (2014), Linking experiment and theory for three-dimensional networked binary metal nanoparticle-triblock terpolymer superstructures, Nature Communications, 5, 3247
111	Thapa, A.K., Pandit, B., Paudel, H.S., Thapa, R., Ida, S., Jasinski, J.B., Sumanasekera, G.U. and Ishihara, T. (2014), Polythiophene mesoporous birnessite-MnO_2/Pd cathode air electrode for rechargeable Li-air battery, Electrochimica Acta, 127, 410-415
112	Ma, W., Xu, H. and Takahara, A. (2014), Substrate-Independent Underwater Superoleophobic Surfaces Inspired by Fish-Skin and Mussel-Adhesives, Advanced Materials Interfaces, 1 (3), 1300092
113	Oda, Y., Horinouchi, A., Kawaguchi, D., Matsuno, H., Kanaoka, S., Aoshima, S. and Tanaka, K. (2014), Effect of Side-Chain Carbonyl Groups on the Interface of Vinyl Polymers with Water, Langmuir, 30 (5), 1215-1219
114	Hyodo, J., Tominaga, K., Ju, Y.-W., Ida, S. and Ishihara, T. (2014), Electrical conductivity and oxygen diffusivity in Cu- and Ga-doped Pr_2NiO_4, Solid State Ionics, 256, 5-10
115	Hyodo, j., Ida, S. and Ishihara, T. (2014), Oxide ionic conductivity in Pr_2(Ni, Cu, Ga)$O_{4+\delta}$-(Ce, Sm)$O_{2-\delta}$ laminated film estimated with the Hebb-Wagner method, Solid State Ionics, 262, 889-892
116	Ida, S., Takashiba, A., Koga, S., Hagiwara, H. and Ishihara, T. (2014), Potential gradient and photocatalytic activity of an ultrathin p-n junction surface prepared with two-dimensional semiconducting nanocrystals, Journal of the American Chemical Society, 136 (5), 1872-1878

117	Jing, H., Higaki, Y., Otsuka, H. and Takahara, A. (2014), Preparation and characterization of polycarbonate nanocomposites based on surface-modified halloysite nanotube, Polymer Journal, 46, 307-312
118	Watanabe, M., Chien, C.-T., Lin, Y.-D., Chang, Y.J., Wen, Y.-S., Goto, K., Shibahara, M., Shinmyozu, T. and Chow, T.J. (2014), Synthesis, physical properties, and structure of TIPS-difuranoacenes, Tetrahedron Letters, 55 (8), 1424-1427
119	Uchida, H.T., Wagner, S., Hamm, M., Kürschner, J., Kirchheim, R., Hjörvarsson, B. and Pundt, A. (2015), Absorption kinetics and hydride formation in magnesium films: Effect of driving force revisited, Acta Materialia, 85, 279-289
120	Lin, H.-J., Matsuda, J., Li, H.-W., Zhu, M. and Akiba, E. (2015), Enhanced hydrogen desorption property of MgH_2 with the addition of cerium fluorides, Journal of Alloys and Compounds, 645 (S1), S392-S396
121	Chen, Y.Z., Ma, X.Y., Shi, X.H., Suo, T., Borchers, C., Zhang, K.H., Liu, F. and Kirchheim, R. (2015), Hardening effects in plastically deformed Pd with the addition of H, Scripta Materialia, 98, 48-51
122	Yamabe, J., Matsunaga, H., Furuya, Y., Hamada, S., Itoga, H., Yoshikawa, M., Takeuchi, E. and Matsuoka, S. (2015), Qualification of chromium-molybdenum steel based on the safety factor multiplier method in *CHMC1-2014*, International Journal of Hydrogen Energy, 40 (1), 719-728
123	Masumura, T., Nakada, N., Tsuchiyama, T. Takaki, S., Koyano, T. and Adachi, K. (2015), The difference in thermal and mechanical stabilities of austenite between carbon- and nitrogen-added metastable austenitic stainless steels, Acta Materialia, 84, 330-338
124	Kobayashi, M., Tanaka, H., Minn, M., Sugimura, J. and Takahara, A. (2014), Interferometry study of aqueous lubrication on the surface of polyelectrolyte brush, ACS Applied Materials and Interfaces, 6 (22), 20365-20371
125	Deutges, M., Barth, H.P., Chen, Y., Borchers, C. and Kirchheim, R. (2015), Hydrogen diffusivities as a measure of relative dislocation densities in palladium and increase of the density by plastic deformation in the presence of dissolved hydrogen, Acta Materialia, 82, 266-274
126	Okazaki, S., Matsunaga, H., Ueda, T., Komata, H. and Endo, M. (2014), A practical expression for evaluating the small shear-mode fatigue crack threshold in bearing steel, Theoretical and Applied Fracture Mechanics, 73, 161-169
127	Zhang, J.-C., Long, Y.-Z., Wang, X. and Xu, C.-N. (2014), Controlling elastico-mechanoluminescence in diphase (Ba,Ca)TiO_3:$Pr^{3+}$by co-doping different rare earth ions, RSC Advances, 4 (77), 40665-40675
128	Matsuda, J., Uchiyama, N., Kanai, T., Harada, K. and Akiba, E. (2014), Effect of Mg/Ni ratio on microstructure of Mg-Ni films deposited by magnetron sputtering, Journal of Alloys and Compounds, 617, 47-51
129	Spyrou, L.A., Sarafoglou, P.I., Aravas, N. and Haidemenopoulos, G.N. (2014), Evaluation of creep damage of INCOLOY 800HT pigtails in a refinery steam reformer unit, Engineering Failure Analysis, 45, 456-469
130	Matsuda, J., Yoshida, K., Sasaki, Y., Uchiyama, N. and Akiba, E. (2014), In situ observation on hydrogenation of Mg-Ni films using environmental transmission electron microscope with aberration correction, Applied Physics Letters, 105, 083903
131	Haidemenopoulos, G.N., Aravas, N. and Bellas, I. (2014), Kinetics of strain-induced transformation of dispersed austenite in low-alloy TRIP steels, Materials Science and Engineering A, 615, 416-423
132	Spyrou, L. and Aravas, N. (2014), Thermo-mechanical modeling of laser spot welded solar absorbers, ASME Journal of Manufacturing Science and Engineering, 137 (1), 011016
133	Park, K., Nishiyama, M., Nakada, N., Tsuchiyama, T. and Takaki, S. (2014), Intense red emitting mechanoluminescence from CaZnOS:Mn,Li with c-axis preferred orientation, Journal of Advanced Dielectrics, 4 (3), 1450017
134	Tu, D., Xu, C.N., Fujio, Y., Kamimura, S., Sakata, Y. and Ueno, N. (2014), Phosphorescence quenching by mechanical stimulus in CaZnOS:Cu, Applied Physics Letters, 105 (1), 011908
135	Tsuchiyama, T., Tsuboi, K., Iwanaga, S., Masumura, T., Macadre, A., Nakada, N. and Takaki, S. (2014), Suppression of Hydrogen Embrittlement by Formation of Stable Austenite-Layer in Metastable Austenitic Stainless Steel, Scripta Materialia, 90-91, 14-16
136	Fujio, Y., Xu, C.N., Nishibori, M., Teraoka, Y.,Kamitani, K., Terasaki, N. and Ueno, N. (2014), Development of highly sensitive mechanoluminescent sensor aiming at small strain measurement, Journal of Advanced Dielectrics, 4 (2), 1450016/1-1450016/6
137	Dadfarnia, M., Somerday, B. P., Schembri, P.E., Sofronis, P., Foulk III, J.W., Nibur, K.A. and Balch, D.K. (2014), On Modeling Hydrogen-Induced Crack Propagation Under Sustained Load, JOM, 66 (8), 1390-1398

138	Borchers, C., Lehmberg, A., Deutges, M., Cižek, J. and Kirchheim, R. (2014), Effect of annealing on point defect population in cold-drawn pearlitic steel wires, Scripta Materialia, 86, 17-19
139	Nagao, A., Martin, M.L., Dadfarnia, M., Sofronis, P. and Robertson, I.M. (2014), The effect of nanosized (Ti,Mo)C precipitates on hydrogen embrittlement of tempered lath martensitic steel, Acta Materialia, 74, 244-254
140	Matsunaga, H., Makizaki, M., Socie, D.F., Yanase, K. and Endo, M. (2014), Acceleration of fatigue crack growth due to occasional mode II loading in 7075 aluminum alloy, Engineering Fracture Mechanics, 123, 126-136
141	Akama, D., Nakada, N., Tsuchiyama, T., Takaki, S. and Hironaka, A. (2014), Discontinuous yielding induced by the addition of nickel to interstitial-free steel, Scripta Materialia, 82, 13-16
142	Park, K., Nishiyama, M. , Nakada, N., Tsuchiyama, T. and Takaki, S. (2014), Effect of the martensite distribution on the strain hardening and ductile fracture behaviors in dual-phase steel, Materials Science and Engineering A, 604, 135-141
143	Kang, D.-S., Koga, N., Sakata, M., Nakada, N., Tsuchiyama, T. and Takaki, S. (2014), Enhanced work hardening by redistribution of oxygen in (α+β)-type Ti-4Cr-0.2O alloys, Materials Science and Engineering A, 606, 101-107
144	Wang, S., Martin, M.L., Sofronis, P., Ohnuki, S., Hashimoto, N. and Robertson, I.M. (2014), Hydrogen-induced intergranular failure of iron, Acta Materialia, 69, 275-282
145	Komoda, R., Kubota, M., Kondo, Y. and Furtado, J. (2014), Effect of oxygen addition on fretting fatigue strength in hydrogen of JIS SUS304 stainless steel, Tribology International, 76, 92-99
146	Obukuro, Y., Matsushima, S., Nakamura, H., Arai, M., Yamada, H. and Xu, C.-N. (2014), Electronic structure of Eu^{2+}-doped $SrAl_2O_4$ using modified Becke-Johnson exchange potential, Solid State Communications, 186, 46-49
147	Laspidou, C.S., Spyrou, L.A., Aravas, N. and Rittmann, B.E. (2014), Material modeling of biofilm mechanical properties, Mathematical Biosciences, 251, 11-15
148	Matsuo, T., Yamabe, J., Matsuoka, S. (2014), Effects of hydrogen on tensile properties and fracture surface morphologies of Type 316L stainless steel, International Journal of Hydrogen Energy, 39 (7), 3542-3551
149	Wu, H., Hamada, S. and Noguchi, H. (2014), Fatigue strength characteristics evaluation of SUH660 considering small fatigue crack propagation behavior and hardness distribution, International Journal of Fatigue, 63, 1-11
150	Kamimura, S., Xu, C.-N., Yamada, H., Terasaki, N. and Fujihala, M. (2014), Long-persistent luminescence in the near-infrared from Nd^{3+}-doped Sr_2SnO_4 for in vivo optical imaging, Japanese Journal of Applied Physics, 53 (9), 092403
151	Nakada, N., Tsuboi, K., Onomoto, T., Tsuchiyama, T., Takaki, S. and Gerhard, I. (2014), Thermodynamics and Kinetics of Solution Nitriding, CALPHAD, 47, 168-173
152	Hosoi, T., Yonekura, T., Sunada, K. and Sasaki, K. (2015), Exchange Current Density of SOFC Electrodes: Theoretical Relations and Partial Pressure Dependencies Rate-Determined by Electrochemical Reactions, Journal of the Electrochemical Society, 162 (1), F136-F152
153	Aydin, Ö., Koshiyama, T., Nakajima, H. and Kitahara, T. (2015), In-situ diagnosis and assessment of longitudinal current variation by electrode-segmentation method in anode-supported microtubular solid oxide fuel cells, Journal of Power Sources, 279, 218-223
154	Perry, N.H., Kim, J.J., Bishop, S.R. and Tuller, H.L. (2015), Strongly coupled thermal and chemical expansion in the perovskite oxide system $Sr(Ti,Fe)O_{3-\alpha}$, Journal of Materials Chemistry A, 3 (7), 3602-3611
155	Perry, N.H., Pergolesi, D., Bishop, S.R. and Tuller, H.L. (2015), Defect Chemistry and Surface Oxygen Exchange Kinetics of La-Doped $Sr(Ti,Fe)O_{3-\alpha}$ in Oxygen-Rich Atmospheres, Solid State Ionics, 273, 18-24
156	Chen, D., Bishop, S.R. and Tuller, H.L. (2014), Nonstoichiometry in oxide thin films operating under anodic conditions: A chemical capacitance study of the praseodymium-cerium oxide system, Chemistry of Materials, 26 (22), 6622-6627
157	Toshimitsu, F. and Nakashima, N. (2014), Semiconducting Single-walled Carbon Nanotubes Sorting with a Removable Solubilizer Based on Dynamic Supramolecular Coordination Chemistry, Nature Communications, 5, 5041
158	Chen, D. and Tuller, H.L. (2014), Voltage-controlled nonstoichiometry in oxide thin films: $Pr_{0.1}Ce_{0.9}O_{2-\delta}$ case study, Advanced Functional Materials, 24 (48), 7638-7644
159	Yang, Z., Berber, M.R. and Nakashima, N. (2014), A Polymer-Coated Carbon Black-based Fuel Cell Electrocatalyst with High CO-Tolerance and Durability in Direct Methanol Oxidation, Journal of Materials Chemistry A, 2 (44), 18875-18880

160	Berber, M.R., Hafez, I.H., Fujigaya, T. and Nakashima, N. (2014), Durability Analysis of Polymer-coated Pristine Carbon Nanotube-based Fuel Cell Electrocatalyst at Non-humidified Conditions, Journal of Materials Chemistry A, 2 (44), 19053-19059
161	Hafez, I.H., Berber, M.R., Fujigaya, T. and Nakashima, N. (2014), Enhancement of Platinum Mass Activity on the Surface of Polymer-wrapped Carbon Nanotube-Based Fuel Cell Electrocatalysts, Scientific Reports, 4, 6295
162	Fujigaya, T., Morita, J. and Nakashima, N. (2014), Grooves of Bundled Single-Walled Carbon Nanotubes Dramatically Enhance the Reactivity of Oxygen Reduction Reaction, ChemCatChem, 6 (11), 3169-1373
163	Yoo, J., Lee, S., Lee, C.K., Kim, C., Fujigaya, T., Park, H.J., Nakashima, N. and Shim, J.K. (2014), Homogeneous decoration of zeolitic imidazolate framework-8 (ZIF-8) with core-shell structures on carbon nanotubes, RSC Advances, 4 (91), 49614-49619
164	Kobayashi, Y., Kosaka, K., Tomida, K., Matake, N., Ito, K. and Sasaki, K. (2014), Start-Up Characteristics of Segmented-In-Series Tubular SOFC Power Modules Improved by Catalytic Combustion at Cathodes, Fuel Cells, 14 (6), 1028-1035
165	Kobayashi, Y., Kosaka, K., Yamamoto, T., Tachikawa, Y., Ito, K. and Sasaki, K. (2014), A Solid Polymer Water Electrolysis System Utilizing Natural Circulation, International Journal of Hydrogen Energy, 39 (29), 16263-16274
166	Bayer, T., Bishop, S.R., Nishihara, M., Sasaki, K. and Lyth, S.M. (2014), Characterization of a graphene oxide membrane fuel cell, Journal of Power Sources, 272, 239-247
167	Christiani, L., Hilaire, S., Sasaki, K. and Nishihara, M. (2014), Evaluation of proton conductivity of sulfonated polyimide/dihydroxy naphthalene charge-transfer complex hybrid membranes, Journal of Polymer Science Part A: Polymer Chemistry, 52 (20), 2991-2997
168	Kim, C.-R., Fujigaya, T. and Nakashima, N. (2014), One-pot Synthesis of Au-Pt Core-shell Nanoparticles on Polybenzimidazole-decorated Carbon Nanotubes, Chemistry Letters, 43 (11), 1737-1739
169	Liu, J., Takeshi, D., Sasaki, K. and Lyth, S.M. (2014), Platinum-Decorated Nitrogen-Doped Graphene Foam Electrocatalysts, Fuel Cells, 14 (5), 728-734
170	Tsukatsune, T., Takabatake, Y., Noda, Z., daio, T., Zaitsu, A., Lyth, S.M., Hayashi, A. and Sasaki, K. (2014), Platinum-Decorated Tin Oxide and Niobium-Doped Tin Oxide PEFC Electrocatalysts: Oxygen Reduction Reaction Activity, Journal of The Electrochemical Society, 161 (12), F1208-F1213
171	Hong, L., Mouri, S., Miyauchi, Y., Matsuda, K. and Nakashima, N. (2014), Redox properties of a single (7,5)single-walled carbon nanotube determined by an in situ photoluminescence spectroelectrochemical method, Nanoscale, 6 (21), 12798-12804
172	Perry, N.H., Bishop, S.R. and Tuller, H.L. (2014), Tailoring Chemical Expansion by Controlling Charge Localization: In Situ X-ray Diffraction and Dilatometric Study of (La,Sr)(Ga,Ni)$O_{3-\delta}$ Perovskite, Journal of Materials Chemistry A, 2 (44), 18906-18916
173	Andersson, M., Nakajima, H., Kitahara, T., Shimizu, A., Koshiyama, T., Paradis, H., Yuan, Jinliang, Y. and Sundén, B. (2014), Comparison of humidified hydrogen and partly pre-reformed natural gas as fuel for solid oxide fuel cells applying computational fluid dynamics, International Journal of Heat and Mass Transfer, 77, 1008-1022
174	Itoh, T., Shimomura, T., Hayashi, A., Yamaguchi, A., Teramae, N., Ono, M., Tsunoda, T., Mizukami, F., Stucky, G.D. and Hanaoka, T.-A. (2014), Electrochemical enzymatic biosensor with long-term stability using hybrid mesoporous membrane, Analyst, 139 (18), 4654-4660
175	Yoon, J.T., Lee, S.B., Lee, C.K., Hwang, S.W., Kim, C.R., Fujigaya, T., Nakashima, N. and Shim, J.K. (2014), Graphene Oxide and Laponite Composite Films with High Oxygen-Barrier Properties, Nanoscale, 6 (18), 10824-10830
176	Sada, T., Fujigaya, T. and Nakashima, N. (2014), Manipulation of cell membrane using carbon nanotube scaffold as a photoresponsive stimuli generator, Science and Technology of Advanced Materials, 15 (4), 045002
177	Nagahisa, R., Kuriya, D., Muramatsu, H., Takata, Y. Ogawa, K. and Ito, K. (2014), Measurement System for Solubility and Self-Diffusivity of Hydrogen Gas Dissolved in Polymer Electrolyte Membrane, Journal of the Electrochemical Society, 161 (10), F1070- F1074
178	Zhao, L., Perry, N.H., Sasaki, K. and Bishop, S.R. (2014), Electronic and ionic conductivity of $Eu_{0.2}Ce_{0.8}O_{2-\delta}$, Solid State Ionics, 263, 75-79
179	Sada, T., Fujigaya, T. and Nakashima, N. (2014), Layer-by-Layer Assembly of Trivalent Metal Cation and Anionic Polymer in Nanoporous Anodic Aluminum Oxide with 35nm Pore, Chemistry Letters, 43 (9), 1478-1480
180	Hanasaki, M., Uryu, C., Daio, T., Kawabata, T., Tachikawa, Y., Lyth, S.M., Shiratori, Y., Taniguchi, S. and Sasaki, K. (2014), SOFC durability against standby and shutdown cycling, Journal of the Electrochemical Society, 161 (9), F850-F860

181	Knauth, P., Engel, J., Bishop, S.R. and Tuller, H.L. (2015), Study of compaction and sintering of nanosized oxide powders by in situ electrical measurements and dilatometry: Nano CeO_2-case study, Journal of Electroceramics, 34 (1), 82-90
182	Liu, J., Takeshi, D., Sasaki, K. and Lyth, S.M. (2014), Defective graphene foam: A platinum catalyst support for PEMFCs, Journal of the Electrochemical Society, 161 (9), F838- F844
183	Engel, J., Bishop, S.R., Vayssieres, L. and Tuller, H.L. (2014), In Situ Electrical Characterization of Anatase TiO_2 Quantum Dots, Advanced Functional Materials, 24 (31), 4952-4958
184	Barile, C.J., Tse, E.C.M., Li, Y., Sobyra, T. B., Zimmerman, S. C., Hosseini, A. and Gewirth, A.A. (2014), Proton switch for modulating oxygen reduction by a copper electrocatalyst embedded in a hybrid bilayer membrane, Nature Materials, 13, 619-623
185	Bishop, S. R., Nakamura, T. and Amezawa, K. (2014), Chemically-induced expansion of $Zr_{0.2}Ce_{0.8}O_{2-\delta}$, Solid State Ionics, 261, 1-4
186	Marrocchelli, D., Chatzichristodoulou, C. and Bishop, S.R. (2014), Defining chemical expansion: The choice of units for the stoichiometric expansion, Physical Chemistry Chemical Physics, 16 (20), 9229-9232
187	Imazu, N., Fujigaya, T. and Nakashima, N. (2014), Fabrication of flexible transparent conductive films from long double-walled carbon nanotubes, Science and Technology of Advanced Materials, 15 (2), 025005
188	Hong, L., Toshimitsu, F., Niidome, Y. and Nakashima, N. (2014), Microenvironment effect on the electronic potentials of individual (6,5)single-walled carbon nanotubes, Journal of Materials Chemistry C, 2 (26), 5223-5228
189	Ishikawa, Y., Shiozawa, M., Kondo, M. and Ito, K. (2014), Theoretical analysis of supercooled states of water generated below the freezing point in a PEFC, International Journal of Heat and Mass Transfer, 74, 215-227
190	Fukumaru, T., Toshimitsu, F., Fujigaya, T. and Nakashima, N. (2014), Effects of the chemical structure of polyfluorene on selective extraction of semiconducting single-walled carbon nanotubes, Nanoscale, 6 (11), 5879-5886
191	Fukumaru, T., Saegusa, Y., Fujigaya, T. and Nakashima, N. (2014), Fabrication of poly(*p*-phenylenebenzobisoxazole) film using a soluble poly(*o*-alkoxyphenylamide) as the precursor, Macromolecules, 47 (6), 2088-2095
192	Bishop, S.R., Marrocchelli, D., Chatzichristodoulou, C., Perry, N.H., Mogensen, M.B., Tuller, H.L. and Wachsman, E.D. (2014), Chemical Expansion: Implications for Electrochemical Energy Storage and Conversion Devices, Annual Review of Materials Research, 44, 205-239
193	Park, E., Taniguchi, S., Daio, T., Chou, J.-T. and Sasaki, K. (2014), Comparison of chromium poisoning among solid oxide fuel cell cathode materials, Solid State Ionics, 262, 421-427
194	Takabatake, Y., Noda, Z., Lyth, S.M., Hayashi, A. and Sasaki, K. (2014), Cycle durability of metal oxide supports for PEFC electrocatalysts, International Journal of Hydrogen Energy, 39 (10), 5074-5082
195	Liu, J.F., Takeshi, D., Orejon, D., Sasaki, K. and Lyth, S.M. (2014), Defective Nitrogen-Doped Graphene Foam: A Metal-Free, Non-Precious Electrocatalyst for the Oxygen Reduction Reaction in Acid, Journal of the Electrochemical Society, 161 (4), F544-F550
196	Kanda, K., Noda, Z., Nagamatsu, Y., Higashi, T., Taniguchi, S., Lyth, S.M., Hayashi, A. and Sasaki, K. (2014), Negligible Start-Stop-Cycle Degradation in a PEFC Utilizing Platinum-Decorated Tin Oxide Electrocatalyst Layers with Carbon Fiber Filler, ECS Electrochemistry Letters, 3 (4), F15-F18
197	Fujigaya, T., Hirata, S. and Nakashima, N. (2014), A Highly-Durable Fuel Cell Electrocatalyst Based on Polybenzimidazole-coated Stacked Graphene, Journal of Materials Chemistry A, 2 (11), 3888-3893
198	Berber, M.R., Fujigaya, T. and Nakashima, N (2014), High-temperature polymer electrolyte fuel cell using poly(vinylphosphonic acid) as an electrolyte shows a remarkable durability, ChemCatChem, 6 (2), 567-571
199	Kim, J., Bishop, S.R., Thompson, N.J., Chen, D. and Tuller, H.L. (2014), Investigation of Nonstoichiometry in Oxide Thin Films by Simultaneous in situ Optical Absorption and Chemical Capacitance Measurements: Pr Doped Ceria - Case Study, Chemistry of Materials, 26 (3), 1374-1379
200	Fujigaya, T., Kim, C., Matsumoto, K. and Nakashima, N. (2014), Palladium-based anion-exchange membrane fuel cell using koh-doped polybenzimidazole as the electrolyte, ChemPlusChem, 79 (3), 400-405
201	Rupp, J.L.M., Fabbri, E., Marrocchelli, D., Han, J.-W., Chen, D., Traversa, E., Tuller, H.L. and Yildiz, B. (2014), Scalable Oxygen-Ion Transport Kinetics in Metal-Oxide Films: Impact of Thermally Induced Lattice Compaction in Acceptor Doped Ceria Films, Advanced Functional Materials, 24 (11), 1562-1574

202	Yeo, J., Yamashita, S., Hayashida, M. and Koyama, S. (2014), A Loop Thermosyphon Type Cooling System for High Heat Flux, Journal of Electronics Cooling and Thermal Control, 4, 128-137
203	Yamada, Y., Ikuta, T., Nishiyama, T., Takahashi, K. and Takata, Y. (2014), Droplet nucleation on a well-defined hydrophilic-hydrophobic surface of 10 nm order resolution, Langmuir, 30 (48), 14532-14537
204	Chakraborty, A., Saha, B.B. and Aristov, Y.I. (2014), Dynamic behaviors of adsorption chiller: Effects of the silica gel grain size and layers, Energy, 78, 304-312
205	Orejon, D., Sefiane, K. and Takata, Y. (2014), Effect of ambient pressure on Leidenfrost temperature, Physical Review E-Statistical, Nonlinear, and Soft Matter Physics, 90 (5), 053012
206	Saha, B.B., El-Sharkawy, I.I., Miyazaki, T., Koyama, S., Henninger, S.K., Herbst, A. and Janiak, C. (2015), Ethanol adsorption onto metal organic framework: Theory and experiments, Energy, 79, 363-370
207	Nishiyama, T., Yamada, Y., Ikuta, T., Takahashi, K. and Takata, Y. (2015), Metastable nanobubbles at the solid-liquid interface due to contact angle hysteresis, Langmuir, 31 (3), 982-986
208	Tripathi, M.K., Sahu, K.C., Karapetsas, G., Sefiane, K. and Matar, O.K. (2015), Non-isothermal bubble rise: non-monotonic dependence of surface tension on temperature, Journal of Fluid Mechanics, 763, 82-108
209	Harish, S., Orejon, D., Takata, Y. and Kohno, M. (2015), Thermal conductivity enhancement of lauric acid phase change nanocomposite in solid and liquid state with single-walled carbon nanohorn inclusions, Thermochimica Acta, 600, 1-6
210	El-Sharkawy, I.I., Uddin, K., Miyazaki, T., Baran Saha, B., Koyama, S., Kil, H.-S., Yoon, S.-H. and Miyawaki, J. (2015), Adsorption of ethanol onto phenol resin based adsorbents for developing next generation cooling systems, International Journal of Heat and Mass Transfer, 81, 171-178
211	Shen, B., Suroto, B.J., Hirabayashi, S., Yamada, M., Hidaka, S., Kohno, M., Takahashi, K. and Takata, Y. (2015), Bubble activation from a hydrophobic spot at “negative“ surface superheats in subcooled boiling, Applied Thermal Engineering, 88, 230-236
212	Long, Z.Q., Zhang, P. and Shen, B. (2015), Natural convection heat transfer of supercritical binary fluid in a long closed vertical cylinder, International Journal of Heat and Mass Transfer, 80, 551-561
213	Kondou, C. and Koyama, S. (2015), Thermodynamic assessment of high-temperature heat pumps using low-GWP HFO refrigerants for heat recovery, International Journal of Refrigeration, 53 (2884), 1126-141
214	Shen, B. and Zhang, P. (2015), Three-dimensional thermoconvection from a non-uniformly heated plate near the liquid-vapor critical point, International Journal of Thermal Sciences, 89, 136-153
215	Sultan, M., El-Sharkawy, I.I., Miyazaki, T., Saha, B.B. and Koyama, S. (2014), Experimental study on carbon based adsorbents for greenhouse dehumidification, EVERGREEN Joint Journal of Novel Carbon Resource Sciences & Green Asia Strategy, 1 (2), 5-11
216	Li, Q.-Y., Zhang, X. and Hu, Y.-D. (2014), Laser flash Raman spectroscopy method for thermophysical characterization of 2D nanomaterials, Thermochimica Acta, 592, 67-72
217	Thu, K., Kim, Y.-D., Ismil, A.B., Saha, B.B. and Ng, K.C. (2014), Adsorption characteristics of methane on Maxsorb III by gravimetric method, Applied Thermal Engineering, 72 (2), 200-205
218	Cho, J., Losego, M.D., Zhang, H.G., Kim, H., Zuo, J., Petrov, I., Cahill, D.G., Braun, P.V. (2014), Electrochemically tunable thermal conductivity of lithium cobalt oxide, Nature Communications, 5, 4035
219	Habib, K., Saha, B.B. and Koyama, S. (2014), Study of various adsorbent-refrigerant pairs for the application of solar driven adsorption cooling in tropical climates, Applied Thermal Engineering, 72 (2), 266-274
220	Miao, T., Ma, W., Zhang, X., Kubo, K., Kohno, M., Takata, Y., Ikuta, T. and Takahashi, K. (2014), Study on the cross plane thermal transport of polycrystalline molybdenum nanofilms by applying picosecond laser transient thermoreflectance method, Journal of Nanomaterials, 2014, 578758
221	Harish, S., Tabara, M., Ikoma, Y., Horita, Z., Takata, Y., Cahill, David, G. and Kohno, M. (2014), Thermal conductivity reduction of crystalline silicon by high-pressure torsion, Nanoscale Research Letters, 9, 326
222	Sakoda, N., Kumagai, R., Ishida, R., Shinzato, K., Kohno, M. and Takata, Y. (2014), Vacuum generation by hydrogen permeation to atmosphere through austenitic and nickel-base-alloy vessel walls at temperatures from 573 K to 773 K, International Journal of Hydrogen Energy, 39 (21), 11316-11320
223	Uddin, K., El-Sharkawy, I.I., Miyazaki, T., Saha, B.B., Koyama, S., Kil, H.-S., Miyawaki, J. and Yoon, S.-H. (2014), Adsorption characteristics of ethanol onto functional activated carbons with controlled oxygen content, Applied Thermal Engineering, 72 (2), 211-218

224	Askalany, A.A., Saha, B.B. and Ismail, I.M. (2014), Adsorption isotherms and kinetics of HFC410A onto activated carbons, Applied Thermal Engineering, 72 (2), 237-243
225	El-Sharkawy, I.I., AbdelMeguid, H. and Saha, B.B. (2014), Potential application of solar powered adsorption cooling systems in the Middle East, Applied Energy, 126, 235-245
226	Ma, W., Miao, T., Zhang, X., Yang, L., Cai, A., Yong, Z. and Li, Q. (2014), Thermal performance of vertically-aligned multi-walled carbon nanotube array grown on platinum film, Carbon, 77, 266-274
227	El-Sharkawy, I.I., Uddin, K., Miyazaki, T., Saha, B.B., Koyama, S., Miyawaki, J. and Yoon, S.-H. (2014), Adsorption of ethanol onto parent and surface treated activated carbon powders, International Journal of Heat and Mass Transfer, 73, 445-455
228	Hayashi, H., Takahashi, K., Ikuta, T., Nishiyama, T., Takata, Y. and Zhang, X (2014), Direct evaluation of ballistic phonon transport in a multi-walled carbon nanotube, Applied Physics Letters, 104 (11), 113112
229	Uddin, K., El-Sharkawy, I.I., Miyazaki, T., Saha, B.B. and Koyama, S. (2014), Thermodynamic Analysis of Adsorption Cooling Cycle using Ethanol-Surface treated Maxsorb III Pairs, EVERGREEN Joint Journal of Novel Carbon Resource Sciences & Green Asia Strategy, 1 (1), 25-31
230	Negeed, E. R., Albeirutty, M. and Takata, Y. (2014), Dynamic behavior of micrometric single water droplets impacting onto heated surfaces with TiO_2 hydrophilic coating, International Journal of Thermal Sciences, 79, 1-17
231	Li, Q.-Y. and Zhang, X. (2014), T-type Raman spectroscopy method for determining laser absorption, thermal conductivity and air heat transfer coefficient of micro/nano fibers, Thermochimica Acta, 581, 26-31
232	Deendarlianto , Takata, Y., Hidaka, S., Indarto, Widyaparaga, A., Kamal, S., Purnomo and Kohno, M. (2014), Effect of static contact angle on the droplet dynamics during the evaporation of a water droplet on the hot walls, International Journal of Heat and Mass Transfer, 71, 691-705
233	Alhamidi, A. and Horita, Z. (2015), Grain refinement and high strain rate superplasticity in alumunium 2024 alloy processed by high-pressure torsion, Materials Science and Engineering A, 622, 139-145
234	Askalany, A.A. and Saha, B.B. (2015), Experimental and theoretical study of adsorption kinetics of Difluoromethane onto activated carbons, International Journal of Refrigeration, 49, 160-168
235	Lee, S., Edalati, K., Iwaoka, H., Horita, Z., Ohtsuki, T., Ohkochi, T., Kotsugi, M., Kojima, T., Mizuguchi, M. and Takanashi, K. (2014), Formation of FeNi with *L*10-ordered structure using high-pressure torsion, Philosophical Magazine Letters, 94 (10), 639-646
236	Hongo, T., Edalati, K., Iwaoka, H., Arita, M., Matsuda, J., Akiba, E. and Horita, Z. (2014), High-pressure torsion of palladium: Hydrogen-induced softening and plasticity in ultrafine grains and hydrogen-induced hardening and embrittlement in coarse grains, Materials Science and Engineering A, 618, 1-8
237	Edalati, K., Matsuda, J., Yanagida, A., Akiba, E. and Horita, Z. (2014), Activation of TiFe for hydrogen storage by plastic deformation using groove rolling and high-pressure torsion: Similarities and differences, International Journal of Hydrogen Energy, 39 (28), 15589-15594
238	Edalati, K., Daio, T., Lee, S., Horita, Z., Nishizaki, T., Akune, T. Nojima, T. and Sasaki, T. (2014), High strength and superconductivity in nanostructured niobium–titanium alloy by high-pressure torsion and annealing: Significance of elemental decomposition and supersaturation, Acta Materialia, 80, 149-158
239	Li, H.W., Yan, Y., Akiba, E. and Orimo, S.-i. (2014), Improved Dehydrogenation and Rehydrogenation Properties of $LiBH_4$ by Nanosized Ni Addition, Materials Transactions, 55 (8), 1134-1137
240	Alhamidi, A. and Horita, Z. (2014), Application of high-pressure torsion to Al-6 %Cu-0.4 %Zr alloy for ultrafine-grain refinement and superplasticity, Journal of Materials Science, 49 (19), 6689-6695
241	Edalati, K., Cubero-Sesin, J.M., Alhamidi, A., Mohamed, I.F. and Horita, Z. (2014), Influence of severe plastic deformation at cryogenic temperature on grain refinement and softening of pure metals: Investigation using high-pressure torsion, Materials Science and Engineering A, 613, 103-110
242	Ikoma, Y., Hayano, K., Edalati, K., Saito, K., Guo, Q., Horita, Z., Aoki, T., Smith, D.J. (2014), Fabrication of nanograined silicon by high-pressure torsion, Journal of Materials Science, 49 (19), 6565-6569
243	Alhamidi, A., Edalati, K., Horita, Z., Hirosawa, S., Matsuda, K. and Terada, D. (2014), Softening by severe plastic deformation and hardening by annealing of aluminum-zinc alloy: Significance of elemental and spinodal decompositions, Materials Science and Engineering A, 610, 17-27

244	Cubero-Sesin, J.M., In, H., Arita, M., Iwaoka, H., Horita, Z. (2014), High-pressure torsion for fabrication of high-strength and high-electrical conductivity Al micro-wires, Journal of Materials Science, 49 (19), 6550-6557
245	Minoda, A., Oshima, S., Iki, H. and Akiba, E. (2014), Hydrogen storage capacity of lithium-doped KOH activated carbons, Journal of Alloys and Compounds, 606, 112-116
246	Akama, D., Lee, S., Horita, Z., Matsuda, K. and Hirosawa, S. (2014), Aging behavior of ultrafine-grained Al-Mg-Si-X (X= Cu, Ag, Pt, Pd) alloys produced by high-pressure torsion, Materials Transactions, 55 (4), 640-645
247	Sakaki, K., Terashita, N., Kim, H., Majzoub, E.H., Machida, A., Watanuki, T., Tsunokake, S., Nakamura, Y. and Akiba, E. (2014), Degradation mechanism against hydrogenation cycles in $Mg_{2-x}Pr_xNi_4$ (x = 0.6 and 1.0), Journal of Physical Chemistry C, 118 (13), 6697-6705
248	Shao, H., Ma, W., Kohno, M., Takata, Y., Xin, G., Fujikawa, S., Fujino, S., Bishop, S. and Li, X. (2014), Hydrogen storage and thermal conductivity properties of Mg-based materials with different structures, International Journal of Hydrogen Energy, 39 (18), 9893-9898
249	Deschamps, A., De Geuser, F., Horita, Lee, S. and Renou, G. (2014), Precipitation kinetics in a severely plastically deformed 7075 aluminium alloy, Acta Materialia, 66, 105-117
250	He, L., Li, H.-W., Hwang, S.-J. and Akiba, E. (2014), Facile solvent-free synthesis of anhydrous alkali metal dodecaborate $M_2B_{12}H_{12}$ (M = Li, Na, K), Journal of Physical Chemistry C, 118 (12), 6084-6089
251	Edalati, K., Daio, T., Arita, M., Lee, S., Horita, Z., Togo, A. and Tanaka, I. (2014), High-pressure torsion of titanium at cryogenic and room temperatures: Grain size effect on allotropic phase transformations, Acta Materialia, 68, 207-213
252	Edalati, K., Akama, D., Nishio, A., Lee, S., Yonenaga, Y., Cubero-Sesin, J.M. and Horita, Z. (2014), Influence of dislocation-solute atom interactions and stacking fault energy on grain size of single-phase alloys after severe plastic deformation using high-pressure torsion, Acta Materialia, 69, 68-77
253	Shao, H., Chen, C., Liu, T. and Li, X. (2014), Phase, microstructure and hydrogen storage properties of Mg-Ni materials synthesized from metal nanoparticles, Nanotechnology, 25 (13), 135704
254	Lee, S., Matsunaga, H., Sauvage, X. and Horita, Z. (2014), Strengthening of Cu-Ni-Si alloy using high-pressure torsion and aging, Materials Characterization, 90, 62-70
255	Alhamidi, A., Edalati, K. and Horita, Z. (2014), Effect of temperature on solid-state formation of bulk nanograined intermetallics during high-pressure torsion, Philosophical Magazine, 94 (9), 867-887
256	Nakai, H., Goto, T., Kitagawa, K., Nonaka, K., Matsumoto, T. and Ogo, S. (2014), A highly luminescent and highly oxygen-sensitive Tb(iii) complex with a tris-aryloxide functionalised 1,4,7-triazacyclononane ligand, Chemical Communications, 50 (99), 15737-15739
257	Sigfridsson, K.G.V., Leidel, N., Sanganas, O., Chernev, P., Lenz, O., Yoon, K.-S., Nishihara, H., Parkin, A., Armstrong, F.A., Dementin, S., Rousset, M., De Lacey, A.L. and Haumann, M. (2015), Structural differences of oxidized iron-sulfur and nickel-iron cofactors in O_2-tolerant and O_2-sensitive hydrogenases studied by X-ray absorption spectroscopy, Biochimica et Biophysica Acta - Bioenergetics, 1847 (2), 162-170
258	Matsumoto, T., Ando, T., Mori, Y., Yatabe, T., Nakai, H. and Ogo, S. (2015), A $(Ni\text{-}SIr)_I$ model for [NiFe]hydrogenase, Journal of Organometallic Chemistry, 796, 73-76
259	Nguyen, N.T., Mori, Y., Matsumoto, T., Yatabe, T., Kabe, R., Nakai, H., Yoon, K.-S. and Ogo, S. (2014), A [NiFe]hydrogenase model that catalyses the release of hydrogen from formic acid, Chemical Communications, 50 (87), 13385-13387
260	Ishizaki, T. and Watanabe, R. (2014), Pressureless Bonding by Use of Cu and Sn Mixed Nanoparticles, Journal of Electronic Materials, 43 (12), 4413-4420
261	Sadakiyo, M., Yamada, T. and Kitagawa, H. (2014), Proton Conductivity Control by Ion Substitution in a Highly Proton-Conductive Metal−Organic Framework, Journal of the American Chemical Society, 136 (38), 13166-13169
262	Nakamori, H., Matsumoto, T., Yatabe, T., Yoon, K.-S., Nakai, H. and Ogo, S. (2014), Synthesis and crystal structure of a dinuclear, monomeric Mn^{II} p-semiquinonato complex, Chemical Communications, 50, 13059-13061
263	Nakai, H., Jeong, K., Matsumoto, T. and Ogo, S. (2014), Catalytic C−F Bond Hydrogenolysis of Fluoroaromatics by $[(\eta^5\text{-}C_5Me_5)Rh^I(2,2'\text{-bipyridine})]$, Organometallics, 33 (17), 4349-4352
264	Yatabe, T., Kikunaga, T., Matsumoto, T., Yoon, K.-S. and Ogo, S. (2014), Synthesis of Aqueous-stable and Water-soluble Mononuclear Nonheme Mn^VOxo Complexes Using H_2O_2 as an Oxidant, Chemistry Letters, 43 (8), 1380-1382

265	Matsumoto, T., Sadakiyo, M., Ooi, M.L., Kitano, S., Yamamoto, T., Matsumura, S., Kato, K., Takeguchi, T. and Yamauchi, M. (2014), CO_2-Free Power Generation on an Iron Group Nanoalloy Catalyst via Selective Oxidation of Ethylene Glycol to Oxalic Acid in Alkaline Media, Scientific Reports, 4, 5620
266	Miyatsu, S., Kofu, M., Nagoe, A., Yamada, T., Sadakiyo, M., Yamada, T., Kitagawa, H., Tyagi, M., García S., V. and Yamamuro, O. (2014), Proton dynamics of two-dimensional oxalate-bridged coordination polymers, Physical Chemistry Chemical Physics, 16 (32), 17295-17304
267	Matsumoto, T., Eguchi, S., Nakai, H., Hibino, T., Yoon, K.-S. and Ogo, S. (2014), [NiFe]hydrogenase from citrobacter sp. s-77 surpasses platinum as an electrode for H_2 oxidation reaction, Angewandte Chemie - International Edition, 53 (34), 8895-8898
268	Sadakiyo, M., Yamada, T., Honda, K., Matsui, H. and Kitagawa, H. (2014), Control of crystalline proton-conducting pathways by water-induced transformations of hydrogen-bonding networks in a metal-organic framework, Journal of the American Chemical Society, 136 (21), 7701-7707
269	Ogo, S. (2014), H_2 and O_2 Activation-A Remarkable Insight into Hydrogenase, Chemical Record, 14 (3), 397-409
270	Sadakiyo, M., Kon-no, M., Sato, K., Nagaoka, K., Kasai, H., Kato, K. and Yamauchi, M. (2014), Synthesis and catalytic application of PVP-coated Ru nanoparticles embedded in a porous metal–organic framework, Dalton Transactions, 43 (29), 11295-11298
271	Nguyen, N.T., Yatabe, T., Yoon, K.-S. and Ogo, S. (2014), Molybdenum-containing membrane-bound formate dehydrogenase isolated from Citrobacter sp. S-77 having high stability against oxygen, pH, and temperature, Journal of Bioscience and Bioengineering, 118 (4), 386-391
272	Oguma, T. and Katsuki, T. (2014), Iron-catalysed asymmetric tandem spiro-cyclization using dioxygen in air as the hydrogen acceptor, Chemical Communications, 50 (39), 5053-5056
273	Yamauchi, M., Okubo, K., Tsukuda, T., Kato, K., Takata, M. and Takeda, S. (2014), Hydrogen-induced structural transformation of AuCu nanoalloys probed by synchrotron X-ray diffraction techniques, Nanoscale, 6 (8), 4067-4071
274	Nakamori, H., Yatabe, T., Yoon, K.-S. and Ogo, S. (2014), Purification and characterization of an oxygen-evolving photosystem II from Leptolyngbya sp. strain O-77, Journal of Bioscience and Bioengineering, 118 (2), 119-124
275	Mizoguchi, H., Uchida, T. and Katsuki, T. (2014), Ruthenium-catalyzed oxidative kinetic resolution of unactivated and activated secondary alcohols with air as the hydrogen acceptor at room temperature, Angewandte Chemie - International Edition, 53 (12), 3178-3182
276	Uchida, T. and Katsuki, T. (2014), Asymmetric nitrene transfer reactions, sulfimidation, aziridination and C-H amination, using azide compounds as nitrene precursors, The Chemical Record, 14 (1), 117-129
277	Nonaka, K., Yoon, K.-S. and Ogo, S. (2014), Biochemical Characterization of Psychrophilic Mn-Superoxide Dismutase from Newly Isolated Exiguobacterium sp. OS-77, Extremophiles, 18 (2), 363-373
278	Sadakiyo, M., Kasai, H., Kato, K., Takata, M. and Yamauchi, M. (2014), Design and synthesis of hydroxide ion-conductive metal-organic frameworks based on salt inclusion, Journal of the American Chemical Society, 136 (5), 1702-1705
279	Taniguchi, I., Kai, T., Duan, S., Kazama, S. and Jinnai, H. (2015), A compatible crosslinker for enhancement of CO_2 capture of poly(amidoamine) dendrimer-containing polymeric membranes, Journal of Membrane Science, 475, 175-183
280	Ma, S., Luo, R., Moniri, S., Lan, Y. and Kenis, P.A.J. (2014), Efficient Electrochemical Flow System with Improved Anode for the Conversion of CO_2 to CO, Journal of The Electrochemical Society, 161 (10), F1124-F1131
281	Kazemifar, F. and Kyritsis, D.C. (2015), Near-critical CO_2 flow measurement and visualization, Journal of Energy Resources Technology, Transactions of the ASME, 137 (1), 012002
282	Taniguchi, I., Ioh, D., Fujikawa, S., Watanabe, T., Matsukuma, Y. and Minemoto, M. (2014), An Alternative CO_2 Capture by Electrochemical Method, Chemistry Letters, 43 (10), 1601-1603
283	Akamatsu, N., Tashiro, W., Saito, K., Mamiya, J.-I., Kinoshita, M., Ikeda, T., Takeya, J., Fujikawa, S., Priimagi, A. and Shishido, A. (2014), Facile strain analysis of largely bending films by a surface-labelled grating method, Scientific Reports, 4, 5377
284	Lee, Y., Maeda, E., Ho, Y.-L., Fujikawa, S. and Delaunay, J.-J. (2014), High sensitivity refractive index sensing with strong light confinement in high-aspect-ratio U-cavity arrays, Sensors and Actuators, B: Chemical, 202, 137-143
285	Ma, S., Lan, Y., Perez, G.M.J., Moniri, S., Kenis and P.J.A. (2014), Silver supported on titania as an active catalyst for electrochemical carbon dioxide reduction, ChemSusChem, 7 (3), 866-874
286	Ikeda, T., Matsuoka, T., Tsuji, T. and Nakayama, T. (2015), Characteristics of the horizontal component of Rayleigh waves in multimode analysis of surface waves, Geophysics, 80 (1), EN1 - EN11

287	Atamanchuk, D., Tengberg, A., Aleynik, D., Fietzek, P., Shitashima, K., Lichtschlag, A., Hall, P.O.J. and Stahl, H. (2015), Detection of CO_2 leakage from a simulated sub-seabed storage site using three different types of pCO_2 sensors, International Journal of Greenhouse Gas Control, 38, 121-134
288	Ikeda, T. and Tsuji, T. (2014), Azimuthal anisotropy of Rayleigh waves in the crust in southern Tohoku area, Japan, Journal of Geographycal Research, 119 (12), 8964-8975
289	Jiang, F. and tsuji, T. (2014), Changes in pore geometry and relative permeability caused by carbonate precipitation in porous media, Physical Review E, 90, 053306
290	Yamabe, H., Tsuji, T., Liang, Y., and Matsuoka, T. (2015), Lattice Boltzmann Simulations of Supercritical CO_2−Water Drainage Displacement in Porous Media: CO_2 Saturation and Displacement Mechanism, Environmental Science and Technology, 49 (1), 537-543
291	Kitamura, K., Jiang, F., Valocchi, A.J., Chiyonobu, S., Tsuji, T. and Christensen, K. T. (2014), The study of heterogeneous two-phase flow around small-scale heterogeneity in porous sandstone by measured elastic wave velocities and lattice Boltzmann method simulation, Journal of Geophysical Research: Solid Earth, 119 (10), 7564-7577
292	Blackford, J., Stahl, H., Bull, J.M., Bergès, B.J.P., Cevatoglu, M., Lichtschlag, A., Connelly, D., James, R.H., Kita, J., Long, D., Naylor, M., Shitashima, K. et al., (2014), Detection and impacts of leakage from sub-seafloor deep geological carbon dioxide storage, Nature Climate Change, 4 (11), 1011-1016
293	Tsuji, T., Ashi, J. and Ikeda, Y. (2014), Strike-slip motion of a mega-splay fault system in the Nankai oblique subduction zone, Earth, Planets and Space, 66 (1), 120
294	Jiang, F., Tsuji, T. and Hu, C. (2014), Elucidating the Role of Interfacial Tension for Hydrological Properties of Two-Phase Flow in Natural Sandstone by an Improved Lattice Boltzmann Method, Transport in Porous Media, 104 (1), 205-229
295	Khakim, M.Y.N., Tsuji, T. and Matsuoka, T. (2014), Lithology-controlled subsidence and seasonal aquifer response in the Bandung basin, Indonesia, observed by synthetic aperture radar interferometry, International Journal of Applied Earth Observation and Geoinformation, 32, 199-207
296	Miyakawa, A., Saito, S., Yamada, Y., Tomaru, H., Kinoshita, M. and Tsuji, T. (2014), Gas hydrate saturation at Site C0002 of IODP Expeditions 314 and 315 in the Kumano Basin, Nankai Trough, Island Arc, 23 (2), 142-156
297	Kamei, R., Pratt, R.G. and Tsuji, T. (2014), Misfit functionals in Laplace-Fourier domain waveform inversion, with application to wide-angle ocean bottom seismograph data, Geophysical Prospecting, 62 (5), 1054-1074
298	Ishitsuka, K., Fukushima, Y., Tsuji, T., Yamada, Y., Matsuoka, T. and Giao, P.H. (2014), Natural surface rebound of the Bangkok plain and aquifer characterization by persistent scatterer interferometry, Geochemistry Geophysics Geosystems, 15 (4), 965-974
299	Barros, J. M. and Christensen, K. T. (2014), Observations of turbulent secondary flows in a rough-wall boundary layer, Journal of Fluid Mechanics, 748, R1
300	Tsuji, T., Kamei, R. and Pratt, R.G. (2014), Pore pressure distribution of a mega-splay fault system in the Nankai trough subduction zone: Insight into up-dip extent of the seismogenic zone, Earth and Planetary Science Letters, 396, 165-178
301	Kitamura, K., Xue, Z., Kogure, T. and Nishizawa, O. (2014), The potential of V_s and V_p-V_s relation for the monitoring of the change of CO_2-saturation in porous sandstone, International Journal of Greenhouse Gas Control, 25, 54-61
302	Willingham, D., Anderson, W., Christensen, K. T. and Barros, J. M. (2014), Turbulent boundary layer flow over transverse aerodynamic roughness transitions: Induced mixing and flow characterization, Physics of Fluids, 26 (2), 025111
303	Oishi, J., Otomo, J., Oshima, Y. and Koyama, M. (2015), The effects of minor elements in $La_{0.6}Sr_{0.4}Co_{0.2}Fe_{0.8}O_{3-\delta}$ cathodes on oxygen reduction reaction, Journal of Power Sources, 277, 44-51
304	Yang, A.L., Sakata, O., Kusada, K., Yayama, T., Yoshikawa, H., Ishimoto, T., Koyama, M., Kobayashi, H. and Kitagawa, H. (2014), The valence band structure of Ag_xRh_{1-x} alloy nanoparticles, Applied Physics Letters, 105 (15), 153109
305	Ishimoto, T., Hamatake, Y., Kazuno, H., Kishida, T. and Koyama, M. (2015), Theoretical study of support effect of Au catalyst for glucose oxidation of alkaline fuel cell anode, Applied Surface Science, 324, 76-81
306	Kikuchi, Y., Kimura, S., Okamoto, Y. and Koyama, M. (2014), A scenario analysis of future energy systems based on an energy flow model represented as functionals of technology options, Applied Energy, 132, 586-601

307	Dowd, A.-M., Itaoka, K., Ashworth, P., Saito, A. and de Best-Waldhober, M. (2014), Investigating the link between knowledge and perception of CO_2 and CCS: An international study, International Journal of Greenhouse Gas Control, 28, 79-87
308	Nakao, K., Ishimoto, T. and Koyama, M. (2014), Sintering simulation for porous material by integrating molecular dynamics and master sintering curve, Journal of Physical Chemistry C, 118 (29), 15766-15772
309	Tsuda, K., Kimura, S., Takaki, T., Toyofuku, Y., Adaniya, K., Shinto, K., Miyoshi, K., Hirata, K., Christiani, L., Takada, M., Kobayashi, N., Baba, S., Nagamatsu, Y. and Takata, M. (2014), Design proposal for hydrogen refueling infrastructure deployment in the Northeastern United States, International Journal of Hydrogen Energy, 39 (14), 7449-7459
310	Liu, S.-S., Koyama, M., Toh, S. and Matsumura, S. (2014), Microstructure evolution of NiO-YSZ cermet during sintering, Solid State Ionics, 262, 460-464
	A.2. Review articles
311	Druce, J., Téllez, H., and Hyodo, J. (2014), Surface segregation and poisoning in materials for low-temperature SOFCs, MRS Bulletin, 39 (9), 810-815
312	Parent, A.R. and Sakai, K. (2014), Progress in Base-Metal Water Oxidation Catalysis, ChemSusChem, 7 (8), 2070-2080
313	Téllez, H., Aguadero, A., Druce, J., Burriel, M., Fearn, S., Ishihara, T., McPhail, D.S. and Kilner, J.A. (2014), New perspectives in the surface analysis of energy materials by combined time-of-flight secondary ion mass spectrometry (ToF-SIMS) and high sensitivity low-energy ion scattering (HS-LEIS), Journal of Analytical Atomic Spectrometry, 29 (8), 1361-1370
314	Ishihara, T. (2014), Oxide ion conductivity in defect perovskite, Pr_2NiO_4 and its application for solid oxide fuel cells, Nippon Seramikkusu Kyokai Gakujutsu Ronbunshi/Journal of the Ceramic Society of Japan, 122 (1423), 179-186
315	Koyama, M., Kimura, S., Kikuchi, Y., Nakagaki, T. and Itaoka, K. (2014), Present Status and Points of Discussion for Future Energy Systems in Japan from the Aspects of Technology Options, Journal of Cheimical Engineering of Japan, 47 (7), 499-513
	A.3. Proceedings
316	Yang, F., Chen, Y., Cai, Z., Tsvetkov, N., Burriel, M., Tellez, H., Yildiz. B., Kilner, J.A., Williams, D.B. and McComb, D.E. (2014), High Resolution Electron Microscopy Characterization of $(La_{0.5}Sr_{0.5})_2CoC_4$ Thin Film Cathode Materials, Microscopy and Microanalysis, 20 (S3), 1912-1913
317	Téllez, H., Druce, J., Ju, Y.-W. and Kilner, J. A. (2014), Decrease of the electrochemically active surface in mixed ionic-electronic conductors (MIECs) by impurity segregation, Proceedings European Fuel Cell Forum 2014
318	Ishihara, T., Inoishi, A. and Ida, S. (2014), Reversible solid state Fe-air rechargeable battery using $LaGaO_3$ based oxide ion conducting electrolyte, Materials Science Forum, 1680-1685
319	Hyodo, J., Tominaga, K., Ju, Y.-W., Ida, S. and Ishihara, T. (2014), Increased Oxide Ion Diffusivity and Surface Exchange on Pr_2NiO_4 Base Oxide by Au Dispersion, ECS Transactions, 61 (1), 123-129
320	Padilla-Rueda, D., Téllez-Lozano, H., Vadillo, J.M. and Laserna, J.J. (2014), Study of Metal Organic Chemical Vapour Deposition (MOCVD) semiconductors III-V hyperstructures with Secondary Ion Mass Spectrometry (SIMS), IOP Conference Series: Materials Science and Engineering, 59, 012002
321	Mori, K., Kubota, K. and Macadre, A. (2014), Fatigue Properties of Ultra-Fine Grain Austenitic Stainless Steel and Effect of Hydrogen, Third The 3rd Japan-China Joint Symposium on fatigue of Engineering Materials and Structures
322	Sofronis, P., Nagao, A., Dadfarnia, M., Wang, S., Martin, M.L., Somderday, B.P., Ritchie, R.O. and Robertson, I.M. (2014), Micromechanics of hydrogen-induced fracture: from experiments and modelling to prognosis, The 4th International Symposium on Steel Science
323	Nagao, A., Smith, C.D., Martin, M.L., Dadfarnia, M., Sofronis, P. and Robertson, I.M. (2014), The role of plasticity in hydrogen embrittlememt fracture of lath martensitic steel, The 4th International Symposium on Steel Science
324	Macadre, A., Tsuboi, K., Nakada, N., Tsuchiyama, T. and Takaki, S. (2014), Ultra-grain refinement effect on tensile and phase transformation behaviour in a metastable austenitic steel charged in hydrogen gas, Procedia Materials Science, 3, 350-356
325	Lorenzino, P., Okazaki, S., Matsunaga, H. and Murakami, Y. (2014), Effect of orientation of small defects on fatigue limit of steels, MATEC Web of Conferences, 12, 07001
326	Macadre, A., Tsuboi, K., Nakada, N., Tsuchiyama, T. and Takaki, S. (2014), Effect of ultra-grain refinement on the tensile behaviour of an austenitic steel charged with hydrogen, Materials Science and Technology Conference and Exhibition 2013, MS and T 2013, 4, 2361-2368

327	Nagao, A., Smith, C.D., Dadfarnia, M., Sofronis, P. and Robertson, I.M. (2014), Interpretation of Hydrogen-induced Fracture Surface Morphologies for Lath Martensitic Steel, Procedia Materials Science, 3, 1700-1705
328	Tsukiyama, K., Nakada, N., Tsuchiyama, T., Takaki, S. and Tomota, Y (2014), Effect of cooling rate after high temperature nitriding on transformation microstructure in low carbon steel, Advanced Materials Research, 922, 773-778
329	Subhi, Z.A., Morita, T. and Fukuda, K. (2014), Analysis of humidity effects on early stage of sliding, Procedia Engineering, 68, 199-204
330	Kubota, M. and Kawakami, K. (2014), High-Cycle Fatigue Properties of Carbon Steel and Work-Hardened Oxygen Free Copper in High Pressure Hydrogen, Advanced Materials Research, 891-892, 575-580
331	Komoda, R., Yoshigai, N., Kubota, M. and Furtado, J. (2014), Reduction in Fretting Fatigue Strength of Austenitic Stainless Steels due to Internal Hydrogen, Advanced Materials Research, 891-892, 891-896
332	Hashimoto, N., Kubo, H. and Wang, S. (2014), Interaction between Vacancy-Hydrogen Complexes and Dislocation Motion in Alpha-Iron, Proceedings of 2014 Materials Research Society (MRS) Fall Meeting
333	Fukuda, K. and Sugimura, J. (2014), The influences of a hydrogen environment on the tribological properties of pure metals, 5th World Tribology Congress, WTC 2013, 3, 2728
334	Nagashima, A., Fujigaya, T. and Nakashima, N. (2014), Effect of nanostructure of the electrocatalyst based on carbon nanotube for the activation overpotential for PEFC, ECS Transactions, 64 (3), 151-157
335	Kitahara, T., Nakajima, H. and Okamura, K. (2014), Influence of GDL Coated with MPL Containing CNTs on PEFC Performance Under Low and High Humidity Conditions, ECS Transactions, 64 (3), 477-483
336	Liu, J., Daio, T., Sasaki, K. and Lyth, S.M. (2014), Defective Nitrogen-Doped Graphene Foam: Clarifying the Role of Nitrogen in Non-Precious ORR Catalysts, ECS Transactions, 64 (3), 271-280
337	Bishop, S.R., Zhao, L., Daio, T., Perry, N. and Sasaki, K. (2014), Oxygen Exchange Kineics of Thin Ftilms Studied by Optical Transmission Relaxation: Correlation with Surface Composition and Microstructure, Microscopy and Microanalysis, 20, 1906-1907
338	Kakihara, Y., Shiratori, Y., Sakamoto, M., Takada, M., Uchida, T., Le, H. and Sasaki, K. (2014), Hydrotalcite-dispersed paper-structured catalyst for dry reforming of methane, 20th World Hydrogen Energy Conference, WHEC 2014, 2, 1411-1415
339	Tachikawa, Y., Nishimura, T., Hosoi, T., Taniguchi, S., Shiratori, Y. and Kazunari, S. (2014), Three Dimensional Numerical Analysis for Direct Internal Reforming Solid Oxide Fuel Cell, Proceeding of WHEC 2014
340	Nakajima, H. (2014), Performance of an anode-supported honeycomb solid oxide fuel cell, Advanced Materials Research, 783-786, 1698-1703
341	Bayer, T., Bishop, B.R., Nishihara, M., Sasaki, K. and Lyth, S.M. (2014), Graphene oxide membrane fuel cells: Utilizing of a new class of ionic conductor, ECS Transactions, 64 (3), 441-448
342	Sasaki, K., Noda, Z., Tsukatsune, T., Kanda, K., Takabatake, Y., Nagamatsu, Y., Daio, T., Lyth, S.A. and Hayashi, A. (2014), Alternative Oxide-Supported PEFC Electrocatalysts, ECS Transactions, 64 (3), 221-227
343	Minamida, Y., Zhao, X., Noda, Z., Hayashi, A. and Sasaki, K. (2014), Characterization of MEAs fabricated by a carbon support with the nano-channel structure, ECS Transactions, 58 (1), 1105-1111
344	Liu, J., Sasaki, K. and Lyth, S.M. (2014), Defective nitrogen-doped graphene foam: A non-precious electrocatalyst for the oxygen reduction reaction in alkaline medium, ECS Transactions, 64 (3), 1161-1172
345	Fujigaya, T., Berber, M.R. and Nakashima, N. (2014), Design of Highly Durable Electrocatalyst for High-Temperature Polymer Electrolyte Fuel Cell, ECS Transactions, 64 (3), 159-169
346	Minamida, Y., Noda, Z., Hayashi, A. and Sasaki, K. (2014), Development of MEAs with Pt/Mesoporous Carbon as a Cathode Catalyst, ECS Transactions, 64 (3), 137-144
347	Nagamatsu, Y., Kanda, K., Noda, Z., Hayashi, A. and Sasaki, K. (2014), Electrochemical Performance of MEAs with Pt/SnO_2 Mixed with Conductive Filler, ECS Transactions, 64 (3), 207-213
348	Bishop, S.R., Chen, D., Sheth, J., Misture, S., Sheldon, B.W., Kim, J.J. and Tuller, H. L. (2014), Impact of Size Scale on Electro-Chemo-Mechanical Coupling Properties in MIECs: Bulk and Thin Film $(Pr,Ce)O_{2-\delta}$, ECS Transactions, 61 (1), 31-36
349	Kitamura, M., Minamida, Y., Zhao, X., Noda, Z., Hayashi, A. and Sasaki, K. (2014), Investigation of Performance and Durability of MEAs at Higher Temperature, ECS Transactions, 64 (3), 755-762

350	Horiguchi, D., Tsukatsune, T., Noda, Z., Hayashi, A. and Sasaki, K. (2014), Pt/SnO_2 Electrocatalysts on Conductive Fillers, ECS Transactions, 64 (3), 215-220
351	Takahashi, K. and Hayashi, H. (2014), Characterization of thermal transport in multiwalled carbon nanotube using FIB irradiation, Thermomechanical Phenomena in Electronic Systems -Proceedings of the Intersociety Conference, 6892439, 1375-1378
352	Ma, W., Zhang, X., Kubo, K., Kohno, M., Takata, Y., Ikuta, T. and Takahashi, K. (2014), Series Study on the Thermal Transport Properties of Nanofilm by Applying Transient Thermoreflectance Method, Proc. 15th International Heat Transfer Conference, IHTC15-9179
353	Yamada, Y., Kusaba, A., Ikuta, T., Nishiyama, T., Takahashi, K. and Takata, Y. (2014), Wettability-driven water condensation in micron- and submicron-scale, Proc. 15th International Heat Transfer Conference, IHTC15-9177
354	Askalany, A.A., Saha, B.B. and Habib, K. (2014), Adsorption cooling system employing activated carbon/R32 adsorption pair, MATEC Web of Conferences, 13, 06001
355	Jerai, F., Miyazaki, T., Saha, B.B., Koyama, S., Maeda, S., Onda, T. and Maruyama, T. (2014), Analysis on adsorber performance for thermally driven chillers, Proceedings of the Grand Renewable Energy 2014
356	Miyazaki, T., El-Sharkawy, I.I., Saha, B.B. and Koyama, S. (2014), Optimized performance of one-bed adsorption cooling system, Proceedings of the 15th International Refrigeration and Air Conditioning Conference at Purdue, 2429/1-2429/7
357	Uddin, K., El-Sharkawy, I.I., Miyazaki, T., Saha, B.B., Koyama, S. (2014), Thermodynamic analysis of adsorption refrigeration cycles using parent and surface treated Maxsorb III/ethanol pairs, Proceedings of the 15th International Refrigeration and Air Conditioning Conference at Purdue, 2456/1-2456/10
358	Yamada, M., Suroto, B.J., Shen, B., Hidaka, S., Kohno, M., Takahashi, K., Kim, J., and Takata, Y. (2014), Effect of Dissolved Air on Subcooled Pool Boiling from a Mixed Wettability Surface, Proceedings of The 101 EUROTHERM Seminar “TRANSPORT PHENOMENA IN MULTIPHASE SYSTEMS”, Ia-6
359	Sultan, M., El-Sharkawy, I.I., Miyazaki, T., Saha, B.B. and Koyama, S. (2014), A study on adsorption of water onto carbon based adsorbents, Proceedings of the 7th Asian Conference on Refrigeration and Air Conditioning, 534
360	El-Sharkawy, I.I., Uddin, K., Miyazaki, T., Saha, B.B. and Koyama, S. (2014), Characterization of adsorbent/refrigerant pairs for developing high performance adsorption cooling systems, Proceedings of the 7th Asian Conference on Refrigeration and Air Conditioning, 258
361	Shen, B., Suroto, B.J., Hirabayashi, S., Yamada, M., Hidaka, S., Kohno, M., Takahashi, K. and Takata, T. (2014), Observation of periodic bubble nucleation on a hydrophobic spot at negative surface superheats under subcooled conditions, Proceedings of the Heat Transfer Symposium 2014, Beijing, 140070
362	Miyazaki, T., El-Sharkawy, I.I., Saha, B.B. and Koyama, S. (2014), Performance simulation of adsorption refrigeration/heat pump with silica gel-water and activated carbon-ethanol combinations, Proceedings of the 7th Asian Conference on Refrigeration and Air Conditioning
363	Miyazaki, T., El-Sharkawy, I.I., Saha, B.B. and Koyama, S. (2014), Performance Prediction of Adsorption Heat Pump Systems Using Activated Carbon and R 32 Pair, Proceedings of the International Sorption Heat Pump Conference 2014, 92
364	Ashida, M., Chen, P., Doi, H., Tsutsumi, Y., Hanawa, T and, Horita, Z. (2014), Microstructures and mechanical properties of Ti-6Al-7Nb processed by high-pressure torsion, Procedia Engineering, 81, 1523-1528
365	Edalati, K. and Horita, Z. (2014), Phase transformations during high-pressure torsion (HPT) in titanium, cobalt and graphite, IOP Conference Series: Materials Science and Engineering, 63 (1), 012099
366	Cubero-Sesin, J.M., Watanabe, M., Arita, M. and Horita, Z. (2014), Aging and precipitation behavior in supersaturated Al-2%Fe alloy produced by high-pressure torsion, Materials Science Forum, 794-796, 766-771
367	Deschamps, A., De Geuser, F., Hutchinson, C.R., Lee, S.W. and Horita, Z. (2014), Dynamic interactions between precipitation and plastic deformation in aluminium alloys, Materials Science Forum, 794-796, 1133-1140
368	Lee, S. and Horita, Z. (2014), Superplasticity of ultra-fine grained 7075 alloy processed by high-pressure torsion, Materials Science Forum, 794-796, 807-810
369	Shao, H. Y. and Li, X. G. (2014), Kinetics and thermodynamics of nanostructured Mg-based hydrogen storage materials synthesized from metal nanoparticles, Advanced Materials Research, 924, 189-192

370	Cubero-Sasin, J.M., Arita, M., Watanabe, M. and Horita, Z. (2014), High strength and high electrical conductivity of UFG Al-2%Fe alloy achieved by high-pressure torsion and aging, IOP Conference Series: Materials Science and Engineering, 63 (1), 012117
371	Mohamed, I.F., Lee, S. and Horita, Z. (2014), Nanostructure control of age-hardenable Al 2024 alloy by high-pressure torsion, IOP Conference Series: Materials Science and Engineering, 63 (1), 012093
372	Yamauchi, M., Heima, M. and Sadakiyo, M. (2014), Development of Nanoalloy Catalysts for Realization of Carbon-Neutral Energy Cycles, Materials Science Forum, 783-786, 2046-2050
373	Yamauchi, M. (2014), Hydrogen-related Properties of Metal and Alloy Nanoparticles, Proceedings of the International Symposium on Science Explored by Ultra Slow Muon (USM2013), 2, 010305
374	Taniguchi, I. and Fujikawa, S. (2014), CO_2 separation with nano-thick polymeric membrane for precombustion, Energy Procedia, 63, 235-242
375	Duan, S., Kai, T., Taniguchi, I. and Kazama, S. (2014), Development of poly(amidoamine) dendrimer/ poly(ethylene glycol) hybrid membranes for CO_2 capture at elevated pressures, Energy Procedia, 63, 167-173
376	Taniguchi, I. and Fujikawa, S. (2014), Preferential CO_2 separation over H_2 with poly(amidoamine) dendrimer-containing polymeric membrane, MRS Proceedings, 1660
377	Fukagawa, H. and Tsuji, T. (2014), A formulation for dissolution in inhomogeneous temperature field, International Symposium on Earth Science and Technology 2014, 158
378	Jiang, F. and Tsuji, T. (2014), Interfacial Tension Effect on Cluster Size Distributions for Residual Trapping of CO_2 in Sandstones, Energy Procedia, 63, 5483-5489
379	Kitamura, K., Yamada, Y., Onishi, K., Tsuji, T., Chiyonobu, S., Sapiie, B., Bahar, A., Danio, H., Muhammad, A., Erdi, A., Sari, V.M., Matsuoka, T., Kadir, G.A.W. and Gundih CCS project team (2014), Potential Evaluation of CO_2 Reservoir Using the Measured Petrophysical Parameter of Rock Samples in the Gundih CCS Project, Indonesia, Energy Procedia, 63, 4965-4970
380	Tsuji, T., Matsuoka, T., Kadir, W.G.A., Hato, M., Takahashi, T., Rachmat Sule, M., Kitamura, K., Yamada, Y., Onishi, K., Widarto, D.S., Sebayang, R.I., Prasetyo, A., Priyono, A., Ariadji, T., Sapiie, B., Widianto, E. and Ratna Asikin, A. (Gundih CCS poject team) (2014), Reservoir Characterization for site Selection in the Gundih CCS Project, Indonesia, Energy Procedia, 63, 6335-6343
381	Fukagawa, H. and Tsuji, T. (2014), A variational analysis of the absorption of supercritical CO_2 in water in porous rock, Research Institute for Applied Mechanics Workshop
382	Asada, A., Thornton, B., Ura, T., Saito, A., Goto, T., Shinohara, M., Okamura, K., Machiyama, H., Tsukioka, S., Asakawa, E., Shitashima, K., Fujii, T., Maki, T., Nishida, S. and Kasaya, T. (2014), Applied sensing for deep-sea mineral exploration, Proceedings of the TECHNO-OCEAN 2014 International Symposium
383	Ikeda, T. and Tsuji, T. (2014), Detecting localized fracture and lithological boundary in shallow formation from surface wave attenuation, International Symposium on Earth Science and Technology 2014, 43
384	Shitashima, K., Maeda, Y. and Ohsumi, T. (2014), Development of detection and monitoring techniques of CO_2 leakage from seafloor in sub-seabed CO_2 storage, Proceedings of 1st International Symposium on Energy Challenges & Mechanics, 2014
385	Cevatoglu, M., Bull, J.M., Connelly, D.P., Lichtschlag, A., Wright, I.C., James, R., Le Bas, T., McPhail, S. and Shitashima, K. (2014), Monitoring techniques using Autonomous Underwater Vehicles for potential seepage of CO_2 from sub-seafloor storage sites, Proceedings of First Applied Shallow Marine Geophysics Conference
386	Jiang, F., Tsuji, T. (2014), Effect of Interfacial Tension on Residual CO_2 Clusters in Sandstone, MMIJ in Kumamoto
387	Jiang, F. (2014), GPU Accelerated Two Phase Flow Simulation in Real Rock using the Lattice Boltzmann Method, GTC Japan 2014
388	Jiang, F. and Tsuji, T. (2014), Investigations on Capillary Trapping Mechanism by a Digital Rock Approach, International Symposium on Earth Science and Technology 2014,155
389	Jiang, F. and Tsuji, T. (2014), Lattice Boltzmann Simulation of Cluster Size Distributions for Residual Trapping of CO_2 in Sandstones, AOGS 2014 in Sapporo
390	Shitashima, K., Maeda, Y. and Sakamoto, A. (2014), Monitoring of leaked CO_2 through sediment, water column and atmosphere in sub-seabed CCS experiment, Proceedings of Asia Oceania Geosciences Society 11th Annual Meeting, 2014
391	Tsuji, T. and Jiang, F. (2014), Time variation of hydrological and elastic properties due to CO_2 mineralization in CCS project: Insights from two-phase flow simulation for large digital rock models, The 63rd JSMS Annual Meeting

392	Itaoka, K., Saito, A., Dowd, A.-M., de Best Waldhober, M. and Ashworth, P. (2014), Influence of the Large Earthquake and Nuclear Plant Accident on Perception of CCS, Energy Procedia, 63, 7133-7140
393	Kimura, S., Honda, K., Kitamura, K., Taniguchi, I., Shitashima, K., Tsuji, T. and Fujikawa, S. (2014), Preliminary Feasibility Study for On-Site Hydrogen Station with Distributed CO_2 Capture and Storage System, Energy Procedia, 63, 4575-4584
	A.4. Other English articles (Letters)
394	Guo, L., Ida, S., Takashiba, A., Daio, T., Teramae, N. and Ishihara, T. (2014), Soft-templating method to synthesize crystalline mesoporous α-Fe_2O_3 films, New Journal of Chemistry, 38 (4), 1392-1395
395	Sakuraya, S., Takahashi, K., Wang, S., Hashimoto, N. and Ohnuki, S. (2014), Physical properties of α-Fe upon the introduction of H, He, C, and N, Solid State Communications, 195, 70-73
396	Ishimoto, T. and Koyama, M. (2014), Theoretical Study on Interaction Energy Between Water and Graphene Model Compounds, Journal of Computer Chemistry, Japan, 13 (3), 171-172
	A.4. Other English articles (Editorial materials)
397	Nicholas, J.D., Qi, Y., Bishop, S.R., and Mukherjee, P.P. (2014), Introduction to Mechano-Electro-Chemical Coupling in Energy Related Materials and Devices, Journal of the Electrochemical Society, 161 (11), Y11-Y12
398	Bishop, S.R., Marrocchelli, D., Sheldon, B.W. and Amezawa, K. (2014), Editorial for the JECR special issue on electro-chemo-mechanics, Journal of Electroceramics, 32 (1), 1-2
399	Saha, B.B., Takata, Y. and Murthy, S.S. (2014), Special issue: Selected papers from the International Symposium on Innovative Materials for Processes in Energy Systems 2013 (IMPRES2013), Applied Thermal Engineering, 72 (2), 151-152
	A.4. Other English articles (Meeting abstracts)
400	Parent, A.R., Utsunomiya, S., Nakazono, T., Lin, S., and Sakai, K. (2014), Species involved in water oxidation by non-heme iron complexes when driven with sodium periodate, Abstracts of Papers of the American Chemical Society, 248, 1076-INOR
401	Ma, W. and Takahara, A. (2014), Superamphiphobic coating based on halloysite clay nanotubes and a catechol bearing fluorinated polymer, Abstracts of Papers of the American Chemical Society, 248, 342-PMSE
402	White, K.L., Takahara, A. and Sue, H.-J. (2014), Surface and size effects on rheology of model nanoplatelets in epoxy, Abstracts of Papers of the American Chemical Society, 248, 57-COLL
403	Shinohara, T., Higaki, Y., Hoshino, T., Masunago, H., Ogawa, H., Okamoto, Y., Aoki, T. and Takahara, A. (2014), Precise characterization of molecular aggregation state and interfacial structure in ordered heterojunction poly(3hexylthiophene)-based photovoltaics, Abstracts of Papers of the American Chemical Society, 247, 399-POLY
404	Takahara, A. and Ma, W. (2014), Superhydrophobic coatings using surface-modified halloysite nanotubes, Abstracts of Papers of the American Chemical Society, 247, 68-COLL
405	Matsunaga, H., Sun, C., Hong, Y. and Murakami, Y. (2014), Dominant Factors for Very High Cycle Fatigue of High Strength Steels, Proceedings of the Sixth International Conference on Very High Cycle Fatigue (VHCF-6), 57
406	Sasaki, K., Noda, Z., Tsukatsune, T., Higashi, T., Nagamatsu, Y., Horiguchi, D., Lyth, S.M. and Hayashi, A. (2014), Electrocatalyst Support Durability, ECS Meeting, 704
407	Shitashima, K., Sakamoto, A. and Fujii, T. (2014), Application of chemical sensors for investigation of sea-floor hydrothermal deposits, Abstracts of 2014 Annual Meeting of Geochemical Society Japan
408	Shitashima, K., Sakamoto, A., Howe, B. and Kaiser, J. (2014), Observation by using the ocean glider installed with pH/pCO_2 sensor, Abstracts of 2014 Annual Meeting of Geochemical Society Japan
	A.4. Other English articles (Book chapters)
409	Watanabe, M. and Chow, T.J. (2014), Chapter 10: Solution-Processed Acenes and Their Applications on Field-Effect Transistor, Organic Structure Design - Applications in Optical and Electronic Devices, Ed. Tahsin J. Chow, Pan Stanford
410	Shibahara, M., Watanabe, M., Miyazaki, T., Fujishige, J., Matsunaga, Y., Tao, K., Hua, Z., Goto, K. and Shinmyozu, T. (2014), Chapter 3: Synthesis, Structure, and Electronic and Photophysical Properties of Donor–Acceptor Cyclophanes, Organic Structure Design - Applications in Optical and Electronic Devices, Ed. Tahsin J. Chow, Pan Stanford
411	Ishihara, T. (2014), Lithium-Air Batteries, Encyclopedia of Applied Electrochemistry, 2, 1188-1193

412	Ishihara, T. (2014), Oxide Ion Conductor, Encyclopedia of Applied Electrochemistry, 2, 1453-1458
413	Ikegami, F., Tsuji, T., Kumagai, H., Ishibashi, J. and Takai, K. (2014), Active rifting structures in Iheya Graben and adjacent area of the mid-Okinawa Trough observed through seismic reflection surveys, Subseafloor Biosphere Linked to Global Hydrothermal Systems; TAIGA Concept, Springer Japan, 361-368
414	Ishibashi, J., Ikegami, F., Tsuji, T. and Urabe, T. (2015), Hydrothermal activity in the Okinawa Trough back-arc basin - geological background and hydrothermal mineralization -, Subseafloor Biosphere Linked to Global Hydrothermal Systems; TAIGA Concept, Springer Japan, 337-359
415	Yamamoto, H., Maruyama, T., Toth, L.G., Kato, K., Furushima, Y., Taira, N., Maeda, Y. and Shitashima, K. (2015), "In situ determination of bacterial growth in mixing zone of hydrothermal vent field on the Hatoma Knoll, southern Okinawa Trough, Subseafloor Biosphere Linked to Hydrothermal Systems, TAIGA Concept, 437-447
	A.5. Articles written in other than English (Original articles in Japanese)
416	Higaki, Y., Suzuki, K., Kojio, K. and Takahara, A. (2015), Molecular Aggregation Structure of a Segmented Poly(urethane-urea) Elastomer Derived from an Amino Acid-Based Diisocyanate, Kobunshi Ronbunshu, 72 (1), 31-36
417	Otsu, T., Tanaka, H. and Sugimura, J. (2014), Effect of temperature on growth of gaseous cavitation in point contact EHL, Toraibarojisuto/Journal of Japanese Society of Tribologists, 59 (10), 648-656
418	Tanaka, Y., Akama, D., Nakada, N., Tsuchiyama, T. and Takaki, S. (2014), Effect of Pearlite Structure on Lattice Strain in Ferrite Estimated by the Williamson-Hall Method, Tetsu-to-Hagané, 100 (10), 1229-1231
419	Nakada, N., Nishiyama, M., Koga, N., Tsuchiyama, T. and Takaki, S. (2014), Hierarchical Strain Distribution Analysis Formed in DP Steel Using a Combination of Metallographic Image and Digital Image Correlation Method, Tetsu-to-Hagané, 100 (10), 1238-1245
420	Koga, N., Fukuyama, M., Nakada, N., Tsuchiyama and Takaki, S. (2014), Transition of Phase Transformation Mechanism by Mn addition in High Nitrogen Austenitic Stainless Steel, Tetsu-to-Hagané, 100 (9), 1165-1171
421	Mizutani, C., Kitahara, T., Nakajima,H., Sasaki, K. and Ito, K. (2014), Analysis of water behavior in PEFC through 3D thermal and temperature distribution measurement by ultrafine thermocouples, Transactions of the Japan Society of Mechanical Engineers, 80 (820), TEP0364
422	Niidome, Y., Tsuru, Y., Hamasaki, Y. and Nakashima, N. (2014), Spectroscopic properties and SEM observations of au-ag core-shell nanorods deposited on ITO plates, Bunseki Kagaku, 63 (11), 857-865
423	Kitahara, T., Nakajima, H. and Tsuda, K. (2014), Water vapor exchange system installed in a polymer electrolyte fuel cell to enhance the performance without humidification, Transactions of the Japan Society of Mechanical Engineers, 80, 820
424	Matsuda, J. and Yoshida, K. (2014), In situ TEM Observation on Hydrogenation of Hydrogen Storage Materials, Kenbikyo (Microscope), 49, 2
425	Taniguchi, I., Kai, T., Duan, S., Kazama, S. and Jinnai, H. (2014), Development of CO_2 separation membrane with poly(amido amine) dendrimer, Journal of the Japanese Society of Microscopy, 71 (5), 202-210
426	Shigei, Y., Tsuji, T., Matsuoka, T., Ikeda, M., Nishizaka, N. and Ishikawa, Y. (2014), Seismic-derived quality factor for lithology classification around the Median Tectonic Line, Journal of the Society of Materials Science, Japan, 63 (3), 250-257
	A.5. Articles written in other than English (Review articles in Japanese)
427	Oda, Y. and Tanaka, K. (2014), Aggregation states and molecular motion of well-defined vinyl polymers at the water interface, Kobunshi Ronbunshu, 71 (8), 343-351
428	Ishihara, T. and Harada, K. (2014), Development of Diesel Particulate Matter Oxidation Catalyst Based on Oxide Ion Conductiong Materials, The Journal of Fuel Cell Technology, 13 (3), 87-92
	A.5. Articles written in other than English (Proceedings in Japanese)
429	Itaoka, K. (2014), Energy technology analyses for deep GHG emission reduction by 2050 in Japan, Proceedings of the Society for Environmental Economics and Policy Studies Annual Meeting 2014.
	A.5. Articles written in other than English (Book chapters in Japanese)
430	Ishihara, T. and Jang, I.C. (2014), Lithium (Li) - Air Rrechargeable Battery and Polymer-coated Li Cathode, Recent Trends of Hight Safety and Evaluation Technologies in Lithium-ion Batteries, 217-226

431	Ishihara, T. and Jang, I.C. (2014), Li - Air Rechargeable Battery and Effects of Electrolyte, Recent Research and Development of Electrolyte Systems for Various Future Energy Storage Devices, 249-257
	A.5. Articles written in other than English (Magazine articles in Japanese)
432	Urabe, T., Nakagawa, S. and Tsuji, T. (2014), Brief outline of the Exp. 301 cruise of JOIDES Resolution in the Juan de Fuca Ridge area, Chikyu Monthly, 64, 24-33
433	Tsuji, T. (2014), Crustal-scale hydrological properties of upper oceanic crust in the eastern flank of Juan de Fuca ridge (IODP Exp 327), Chikyu Monthly, 65, 154-160
	B. WPI-related papers
	B.1. Original articles
434	Suzuki, Y., Zhang, Q. and Adachi, C. (2015), A solution-processable host material of 1,3-bis{3-[3-(9-carbazolyl)phenyl]-9-carbazolyl}benzene and its application in organic light-emitting diodes employing thermally activated delayed fluorescence, Journal of Materials Chemistry C, 3 (8), 1700-1706
435	Mitome, H., Ishizuka, T., Shiota, Y., Yoshizawa, K. and Kojima, T. (2015), Controlling the redox properties of a pyrroloquinolinequinone (PQQ) derivative in a ruthenium(ii) coordination sphere, Dalton Transactions, 44 (7), 3151-3158
436	Baginska, M., Kaitz, J.A., Jones, A.R., Long, B.R., Gewirth, A.A., Sottos, N.R., Moore, J.S. and White, S.R. (2015), Electropolymerization of microencapsulated 3-hexylthioph for lithium-ion battery applications, Journal of the Electrochemical Society, 162 (3), A373-A377
437	Matsushima, T., Esaki, Y. and Adachi, C. (2014), Enhancement of the electrical characteristics of metal-free phthalocyanine films using cold isostatic pressing, Applied Physics Letters, 105 (24), 243301
438	Kim, S.H., Mohseni, P.K., Song, Y., Ishihara, T. and Li, X. (2015), Inverse metal-assisted chemical etching produces smooth high aspect ratio InP nanostructures, Nano Letters, 15 (1), 641-648
439	Mineart, K.P., Jiang, X., Jinnai, H., Takahara, A. and Spontak, R.J. (2015), Morphological Investigation of Midblock-Sulfonated Block Ionomers Prepared from Solvents Differing in Polarity, Macromolecular Rapid Communications, 36 (5), 432-438
440	Fujii, K., Ito, M., Sato, Y., Takenaka, S. and Kishida, M. (2015), Performance and durability of carbon black-supported Pd catalyst covered with silica layers in membrane-electrode assemblies of proton exchange membrane fuel cells, Journal of Power Sources, 279, 100-106
441	Song, Y. and Li, X.L. (2014), Scaling junctionless multigate field-effect transistors by step-doping, Applied Physics Letters, 105 (22), 223506
442	Sim, J.H., Dong, S., Röemhild, K., Kaya, A., Sohn, D., Tanaka, K., Roman, M., Heinze, T. and Esker, A.R. (2015), 2-Hydroxypropyltrimethylammonium xylan adsorption onto rod-like cellulose nanocrystal, Journal of Colloid and Interface Science, 440, 119-125
443	Sato, T., Uejima, M., Tanaka, K., Kaji, H. and Adachi, C. (2015), A light-emitting mechanism for organic light-emitting diodes: molecular design for inverted singlet–triplet structure and symmetry-controlled thermally activated delayed fluorescence, Journal of Materials Chemistry C, 3 (4), 870-878
444	Kanahara, M., Satoh, H., Higuchi, T., Takahara, A., Jinnai, H., Harano, K., Okada, S., Nakamura, E., Matsuo, Y. and Yabu, H. (2015), Fabrication of NIR-Excitable SERS-Active Composite Particles Composed of Densely Packed Au Nanoparticles on Polymer Microparticles, Particle & Particle Systems Characterization, 32 (4), 441-447
445	Liu, R., Ishimatsu, R., Yahiro, M., Adachi, C., Nakano, K. and Imato, T. (2015), Fluorometric flow-immunoassay for alkylphenol polyethoxylates on a microchip containing a fluorescence detector comprised of an organic light emitting diode and an organic photodiode, Talanta, 134, 37-47
446	Druce, J. and Kilner, J.A. (2014), Improvement of Oxygen Surface Exchange Kinetics for CGO with Surface Treatment, Journal of the Electrochemical Society, 161 (1), F99-F104
447	Esbenshade, J.L., Fox, M.D. and Gewirth, A.A. (2015), $LiMn_2O_4$@Au Particles as Cathodes for Li-Ion Batteries, Journal of the Electrochemical Society, 162 (1), A26-A29
448	Hsieh, Y-T., Ishige, R., Higaki, Y., Woo, E.M. and Takahara, A. (2014), Microscopy and microbeam X-ray analyses in poly(3-hydroxybutyrate-co-3-hydroxyvalerate) with amorphous poly(vinyl acetate), Polymer, 55 (26), 6906-6914
449	Zhu, T. and Ertekin, E. (2014), Phonon transport on two-dimensional graphene/boron nitride superlattices, Physical Review B - Condensed Matter and Materials Physics, 90, 195209

450	Morishige, N., Shin-Gyou-Uchi, R., Azumi, H., Ohta, H., Morita, Y., Yamada, N., Kimura, K., Takahara, A. and Sonoda, K.H. (2014), Quantitative Analysis of Collagen Lamellae in the Normal and Keratoconic Human Cornea by Second Harmonic Generation Imaging Microscopy, Investigative ophthalmology & visual science, 55 (12), 8377-8385
451	Zhang, Z., Sadakane, M., Noro, S., Murayama, T., Kamachi, T., Yoshizawa, K. and Ueda, W. (2015), Selective carbon dioxide adsorption of ε-Keggin-type zincomolybdate-based purely inorganic 3D frameworks, Journal of Materials Chemistry A, 3 (2), 746-755
452	Ohzu, S., Ishizuka, T., Kotani, H., Shiota, Y., Yoshizawa, K., and Kojima, T. (2014), Tetranuclear Ruthenium(II) Complex with a Dinucleating Ligand Forming Multi-Mixed-Valence States, Inorganic Chemistry, 53 (24), 12677-12679
453	Hitaoka, S., Chuman, H. and Yoshizawa, K. (2015), A QSAR study on the inhibition mechanism of matrix metalloproteinase-12 by arylsulfone analogs based on molecular orbital calculations, Organic and Biomolecular Chemistry, 13 (3), 793-806
454	Kojima, T., Kobayashi, R., Ishizuka, T., Yamakawa, S., Kotani, H., Nakanishi, T., Ohkubo, K., Shiota, Y., Yoshizawa, K. and Fukuzumi, S. (2014), Binding of scandium ions to metalloporphyrin-flavin complexes for long-lived charge separation, Chemistry - A European Journal, 20 (47), 15518-15532
455	Ida, S., Koga, S., Daio, T., Hagiwara, H. and Ishihara, T. (2014), Direct imaging of light emission centers in two-dimensional crystals and their luminescence and photocatalytic properties, Angewandte Chemie - International Edition, 53 (48), 13078-13082
456	Kotani, H., Kaida, S., Ishizuka, T., Sakaguchi, M., Ogura, T., Shiota, Y., Yoshizawa, K. and Kojima, T. (2015), Formation and characterization of a reactive chromium(V)-oxo complex: Mechanistic insight into hydrogen-atom transfer reactions, Chemical Science, 6 (2), 945-955
457	Jay, E.E., Rushton, M.J.D., Chroneos, A., Grimes, R.W. and Kilner, J.A. (2015), Genetics of superionic conductivity in lithium lanthanum titanates, Physical Chemistry Chemical Physics, 17 (1), 178-183
458	Kim, S.K., Shim, C.-H., Edura, T., Adachi, C. and Hattori, R. (2014), Improved organic thin-film transistor characteristics using an elevated-electrode structure, Japanese Journal of Applied Physics, 53 (11), 111601
459	Yakushev, M.V., Rodina, A.V., Shuchalin, G.M., Seisian, R.P., Abdullaev, M.A., Rockett, A., Zhivulko, V.D., Mudryi, A.V., Faugeras, C. and Martin, R.W. (2014), Landau levels of the C-exciton in $CuInSe_2$ studied by magneto-transmission, Applied Physics Letters, 105 (14), 142103
460	Yao, Z.-S., Mito, M., Kamachi, T., Shiota, Y., Yoshizawa, K., Azuma, N., Miyazaki, Y., Takahashi, K., Zhang, K., Nakanishi, T., Kang, S., Kanegawa, S. and Sato, O. (2014), Molecular motor-driven abrupt anisotropic shape change in a single crystal of a Ni complex, Nature Chemistry, 6 (12), 1079-1083
461	Cao, Y., Wu, H., Higaki, Y., Jinnai, H. and Takahara, H. (2014), Molecular self-assembly of nylon-12 nanorods cylindrically confined to nanoporous alumina, IUCrJ, 1 (6), 439-445
462	Kasahara, T., Matsunami, S., Edura, T., Ishimatsu, R., Oshima, J., Tsuwaki, M., Imato, T., Shoji, S., Adachi, C. and Mizuno, J. (2015), Multi-color microfluidic organic light-emitting diodes based on on-demand emitting layers of pyrene-based liquid organic semiconductors with fluorescent guest dopants, Sensors and Actuators B: Chemical, 207, Part A, 481-489
463	Berenov, A., Atkinson, A., Kilner, J., Ananyev, M., Eremin, V., Porotnikova, N., Farlenkov, A., Kurumchin, E., Bouwmeester, H.J.M., Bucher, E. and Sitte, W. (2014), Oxygen tracer diffusion and surface exchange kinetics in $Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O_{3-\delta}$, Solid State Ionics, 268, Part A, 102-109
464	Wu, F., Li, J., Tong, H., Li, Z., Adachi, C., Langlois, A., Harvey, P.D., Liu, L., Wong, W.-Y., Wong, W.-K. and Zhu, X. (2015), Phosphorescent Cu(i) complexes based on bis(pyrazol-1-yl-methyl)-pyridine derivatives for organic light-emitting diodes, Journal of Materials Chemistry C, 3 (1), 138-146
465	Huang, W., Koric, S., Yu, X., Hsia, K.J. and Li, X.L. (2014), Precision Structural Engineering of Self-Rolled-up 3D Nanomembranes Guided by Transient Quasi-Static FEM Modeling, Nano Letters, 14 (11), 6293-6297
466	Zhang, C., Miao, X., Mohseni, P.K., Choi, W. and Li, X.L. (2014), Site-Controlled VLS Growth of Planar Nanowires: Yield and Mechanism, Nano Letters, 14 (12), 6836-6841
467	Watanabe, H., Fujimoto, A. and Takahara, A. (2014), Surface functionalization by decal-like transfer of thermally cross-linked urushiol thin films, ACS Applied Materials and Interfaces, 6 (21), 18517-18524
468	Maeda, T., Kamimura, S., Ohishi, T., Takahara, A. and Otsuka, H. (2014), Synthesis of polyethylene/polyester copolymers through main chain exchange reactions via olefin metathesis, Polymer (United Kingdom), 55 (24), 6245-6251

469	Froeter, P., Huang, Y., Cangellaris, O.V., Huang, W., Dent, E.W., Gillette, M.U., Williams, J.C. and Li, X.L. (2014), Toward Intelligent Synthetic Neural Circuits: Directing and Accelerating Neuron Cell Growth by Self-Rolled-Up Silicon Nitride Microtube Array, ACS Nano, 8 (11), 11108-11117
470	Ning, H., Krueger, N.A., Sheng, X., Keurn, H., Zhang, C., Choquette, K.D., Li, X.L., Kim, S., Rogers, J.A. and Braun, P.V. (2014), Transfer-Printing of Tunable Porous Silicon Microcavities with Embedded Emitters, ACS Photonics, 1 (11), 1144-1150
471	Jung, K.H., Mohseni, P.K. and Li, X.L. (2014), Ultrathin InAs nanowire growth by spontaneous Au nanoparticle spreading on indium-rich surfaces, Nanoscale, 6 (24), 15293-15300
472	Miyazaki, T., Tanaka, H., Tanabe, Y., Yuki, M., Nakajima, K., Yoshizawa, K. and Nishibayashi, Y. (2014), Cleavage and Formation of Molecular Dinitrogen in a Single System Assisted by Molybdenum Complexes Bearing Ferrocenyldiphosphine, Angewandte Chemie - International Edition, 53 (43), 11488-11492
473	Hirata, S., Totani, K., Yamashita, T., Adachi, C. and Vacha, M. (2014), Large reverse saturable absorption under weak continuous incoherent light, Nature Materials, 13, 938-946
474	Su, J., Imato, K., Sato, T., Ohishi, T., Takahara, A. and Otsuka, H. (2014), Plasticizer-promoted thermal crosslinking of a dynamic covalent polymer with complementarily reactive alkoxyamine units in the side chain under bulk conditions, Bulletin of the Chemical Society of Japan, 87 (9), 1023-1025
475	Taub, S., Williams, R.E.A., Wang, X., McComb, D.W., Kilner, J.A. and Atkinson, A. (2014), The effects of transition metal oxide doping on the sintering of cerium gadolinium oxide, Acta Materialia, 81, 128-140
476	Fujii, S., Nishina, K., Yamada, S., Mochizuki, S., Ohta, N., Takahara, A. and Sakurai, K. (2014), Micelles consisting of choline phosphate-bearing Calix[4]arene lipids, Soft Matter, 10 (41), 8216-8223
477	He, X.Q., Brown, G., Demirkan, K., MacKie, N., Lordi, V. and Rockett, A. (2014), Microstructural and chemical investigation of PVD-CdS/PVD-$CuIn_{1-x}Ga_xSe_2$ heterojunctions: A transmission electron microscopy study, IEEE Journal of Photovoltaics, 4 (6), 1625-1629
478	Kasahara, T., Matsunami, S., Edura, T., Ishimatsu, R., Oshima, J., Tsuwaki, M., Imato, T., Shoji, S., Adachi, C., and Mizuno, J. (2014), Multi-color microfluidic electrochemiluminescence cells, Sensors and Actuators A: Physical, 214, 225-229
479	Liu, R., Ishimatsu, R., Yahiro, M., Adachi, C., Nakano, K. and Imato, T. (2015), Photometric flow injection determination of phosphate on a PDMS microchip using an optical detection system assembled with an organic light emitting diode and an organic photodiode, Talanta, 132, 96-105
480	Watanabe, H., Fujimoto, A., Yamamoto, R., Nishida, J., Higaki, Y., and Takahara, A. (2014), Polymer Brush Growth from Surface-textured Thin Urushiol Films, Chemistry Letters, 43 (11), 1776-1778
481	Kubo, G., Sakamoto, S., Fujii, S., Sanada, Y., Yasunaga, T., Takahara, A. and Sakurai, K. (2014), Transformation from Multi- to Single-lamellar Vesicle by Addition of a Cationic Lipid to 1,2-Dilauroyl-sn-glycero-3-phosphocholine Explored with SAXS and TEM, Chemistry Letters, 43 (11), 1785-1787
482	Aguesse F., Lopez del Amo, J.M., Roddatis, V., Aguadero, A. and Kilner, J.A. (2014), Enhancement of the Grain Boundary Conductivity in Ceramic $Li_{0.34}La_{0.55}TiO_3$ Electrolytes in a Moisture-Free Processing Environment, Advanced Materials Interfaces, 1 (7), 1300143
483	Kilner, J.A. and Burriel, M. (2014), Materials for intermediate-temperature solid-oxide fuel cells, Annual Review of Materials Research, 44, 365-393
484	Sato, T., Amamoto, Y., Ohishi, T., Higaki, Y., Takahara, A. and Otsuka, H. (2014), Radical crossover reactions of a dynamic covalent polymer brush for reversible hydrophilicity control, Polymer (United Kingdom), 55 (18), 4586-4592
485	Matsuda, Y., Shiokawa, Y., Kikuchi, M., Takahara, A. and Tasaka, S. (2014), Structure of insoluble complex formed by a block copolymer of 2-ethyl-2-oxazoline and ethylene oxide and poly(methacrylic acid), Polymer (United Kingdom), 55 (18), 4757-4764
486	Enomoto, R., Sato, M., Fujii, S., Hirai, T., Takahara, A., Ishihara, K. and Yusa, S.-i. (2014), Surface patterned graft copolymerization of hydrophilic monomers onto hydrophobic polymer film upon UV irradiation, Journal of Polymer Science, Part A: Polymer Chemistry, 52 (19), 2822-2829
487	Kuriyama, S., Arashiba, K., Nakajima, K., Tanaka, H., Kamaru, N., Yoshizawa, K. and Nishibayashi, Y. (2014), Catalytic formation of ammonia from molecular dinitrogen by use of dinitrogen-bridged dimolybdenum-dinitrogen complexes bearing pnp-pincer ligands: Remarkable effect of substituent at pnp-pincer ligand, Journal of the American Chemical Society, 136 (27), 9719-9731

488	Doitomi, K., Tanaka, H., Kamachi, T., Toraya, T. and Yoshizawa, K. (2014), Computational mutation design of diol dehydratase: Catalytic ability toward glycerol beyond the wild-type enzyme, Bulletin of the Chemical Society of Japan, 87 (9), 950-959
489	White, K.L., Li, P., Yao, H., Nishimura, R. and Sue, H.-J. (2014), Effect of surface modifier on flow properties of epoxy suspensions containing model plate-like nanoparticles, Rheologica Acta, 53 (7), 571-583
490	Mayr, C., Lee, S.Y., Schmidt, T.D., Yasuda, T., Adachi, C. and Brütting, W. (2014), Efficiency Enhancement of Organic Light-Emitting Diodes Incorporating a Highly Oriented Thermally Activated Delayed Fluorescence Emitter, Advanced Functional Materials, 24 (33), 5232-5239
491	Tsuwaki, M., Kasahara, T., Edura, T., Matsunami, S., Oshima, J., Shoji, S., Adachi, C. and Mizuno, J. (2014), Fabrication and characterization of large-area flexible microfluidicorganic light-emitting diode with liquid organic semiconductor, Sensors and Actuators A: Physical, 216, 231-236
492	Seike, Y., Koishikawa, Y., Kato, M., Miyachi, K., Kurokawa, S., Doi, A., Miyazaki, H. and Adachi, C. (2014), Late-news poster: The study of film formation process by electrospray method to manufacture high productivity organic light-emitting diode devices, Digest of Technical Papers - SID International Symposium, 45 (1), 1593-1596
493	Li, P., White, K.L., Lin C.-H., Kim, D., Muliana, A., Krishnamoorti, R., Nishimura, R., and Sue, H.-J. (2014), Mechanical Reinforcement of Epoxy with Self-Assembled Synthetic Clay in Smectic Order, ACS Applied Materials & Interfaces, 6 (13), 10188-10195
494	Yamamoto, H. Weaver, M.S., Murata, H., Adachi, C. and Brown, J.J. (2014), Understanding extrinsic degradation in phosphorescent OLEDs, Digest of Technical Papers - SID International Symposium, 45 (1), 758-761
495	Takahara, A., Takeda, T., Kanaya, T., Kido, N., Sakurai, K., Masunaga, H., Ogawa, H. and Takata, M. (2014), Advanced Soft Material Beamline Consortium at SPring-8 (FSBL), Synchrotron Radiation News, 27 (3), 19-23
496	Bernuy-Lopez, C., Manalastas, W., Lopez Del Amo, J.M., Aguadero, A., Aguesse, F. and Kilner, J.A. (2014), Atmosphere controlled processing of ga-substituted garnets for high li-ion conductivity ceramics, Chemistry of Materials, 26 (12), 3610-3617
497	Authors of Document Cavallaro, A., Harrington, G.F., Skinner, S.J. and Kilner, J.A. (2014), Controlling the surface termination of $NdGaO_3$ (110): The role of the gas atmosphere, Nanoscale, 6 (13), 7263-7273
498	Ishimatsu, R., Matsunami, S., Kasahara, T., Mizuno, J., Edura, T., Adachi, C., Nakano, K. and Imato, T. (2014), Electrogenerated chemiluminescence of donor-acceptor molecules with thermally activated delayed fluorescence, Angewandte Chemie - International Edition, 53 (27), 6993-6996
499	Yoshinaga, K., Yang, Y., Ohno, T., Motokucho, S. and Kojio, K. (2014), Inclusion of fullerene in polymer chains grafted on silica nanoparticles in an organic solvent, Polymer Journal, 46 (9), 623-627
500	Li, J. and Yoshizawa, K. (2015), Mechanistic aspects in the direct synthesis of hydrogen peroxide on PdAu catalyst from first principles, Catalysis Today, 248, 142-148
501	Higuchi, T., Murakami, D., Nishiyama, H., Suga, M., Takahara, A. and Jinnai, H. (2014), Nanometer-scale real-space observation and material processing for polymer materials under atmospheric pressure: Application of atmospheric scanning electron microscopy, Electrochemistry, 82 (5), 359-363
502	Yamada, T., Kokado, K., Higaki, Y., Takahara, A. and Sada, K. (2014), Preparation and Morphology Variation of Lipophilic Polyelectrolyte Brush Functioning in Non-Polar Solvents, Chemistry Letters, 43 (8), 1300-1302
503	Sajith, P.K., Shiota, Y. and Yoshizawa, K. (2014), Role of acidic proton in the decomposition of NO over dimeric Cu(I) active sites in Cu-ZSM-5 catalyst: A QM/MM study, ACS Catalysis, 4 (6), 2075-2085
504	Nagashima, T., Nakabayashi, T., Suzuki, T., Kanaizuka, K., Ozawa, H., Zhong, Y.-W., Masaoka, S., Sakai, K. and Haga, M. (2014), Tuning of Metal-Metal Interactions in Mixed-Valence States of Cyclometalated Dinuclear Ruthenium and Osmium Complexes Bearing Tetrapyridylpyrazine or -benzene, Organometallics, 33 (18), 4893-4904
505	Uejima, M., Sato, T., Detani, M., Wakamiya, A., Suzuki, F., Suzuki, H., Fukushima, T., Tanaka, K., Murata, Y., Adachi, C. and Kaji, H. (2014), A designed fluorescent anthracene derivative: Theory, calculation, synthesis, and characterization, Chemical Physics Letters, 602, 80-83
506	House, S.D., Liu, X., Rockett, A.A., Majzoub, E.H. and Robertson, I.M. (2014), Characterization of the dehydrogenation process of $LiBH_4$ confined in nanoporous carbon, Journal of Physical Chemistry C, 118 (17), 8843-8851

507	Date, T., Ueda, Y., Atarashi, H., Sawada, T., Matsuzawa, H., Tanaka, K. and Serizawa, T. (2014), Difference in Protein Adsorption Onto Polymer Films With or Without Thermal Annealing, Journal of Nanoscience and Nanotechnology, 14 (4), 3106-3111
508	Tanaka, H., Arashiba, K., Kuriyama, S., Sasada, A., Nakajima, K., Yoshizawa, K. and Nishibayashi, Y. (2014), Unique behaviour of dinitrogen-bridged dimolybdenum complexes bearing pincer ligand towards catalytic formation of ammonia, Nature Communications, 5, 3737
509	El-Ghamry, H.A., Masaoka, S. and Sakai, K. (2014), Hydrogen-bonded frameworks of propylenediamine-N,N'-diacetic acid Pt(II) complexes, synthesis, structural characterization, and antitumor activity, Journal of Coordination Chemistry, 67 (6), 943-955
510	Mohseni, P.K., Behnam, A., Wood, J.D., Zhao, X., Yu, K.J., Wang, N.C., Rockett, A., Rogers, J.A., Lyding, J.W., Pop, E. and Li, X. (2014), Monolithic III-V nanowire solar cells on graphene via direct van der waals epitaxy, Advanced Materials, 26 (22), 3755-3760
511	Kim, J.-H., Kim, M., Jinnai, H., Shin, T.J., Kim, H., Park, J.H., Jo, S.B. and Cho, K. (2014), Organic solar cells based on three-dimensionally percolated polythiophene nanowires with enhanced charge transport, ACS Applied Materials and Interfaces, 6 (8), 5640-5650
512	Bayliss, R.D., Cook, S.N., Kotsantonis, S., Chater, R.J., Kilner, J.A. (2014), Oxygen ion diffusion and surface exchange properties of the α- and δ-phases of Bi_2O_3, Advanced Energy Materials, 4 (10), 1301575
513	Lee, H., Jeon, Y., Lee, Y., Lee, S.U., Takahara, A. and Sohn, D. (2014), Thermodynamic control of diameter-modulated aluminosilicate nanotubes, Journal of Physical Chemistry C, 118 (15), 8148-8152
514	Kato, K., Hatasako, Y., Uchino, M., Nakata, Y., Suzuki, Y., Hayakawa, T., Adachi, C. and Miyazaki, K. (2014), Flexible Porous Bismuth Telluride Thin Films with Enhanced Figure of Merit using Micro-Phase Separation of Block Copolymer, Advanced Materials Interfaces, 1 (2), 1300015
515	Su, J., Amamoto, Y., Sato, T., Kume, M., Inada, T., Ohishi, T., Higaki, Y., Takahara, A. and Otsuka, H. (2014), Reversible cross-linking reactions of alkoxyamine-appended polymers under bulk conditions for transition between flow and rubber-like states, Polymer (United Kingdom), 55 (6), 1474-1480
516	Kodera, M., Tsuji, T., Yasunaga, T., Kawahara, Y., Hirano, T., Hitomi, Y., Nomura, T., Ogura, T., Kobayashi, Y., Sajith, P.K., Shiota, Y. and Yoshizawa, K. (2014), Roles of carboxylate donors in O-O bond scission of peroxodi-iron(iii) to high-spin oxodi-iron(iv) with a new carboxylate-containing dinucleating ligand, Chemical Science, 5 (6), 2282-2292
517	Watanabe, H., Fujimoto, A., Yamamoto, R., Nishida, J., Kobayashi, M. and Takahara, A. (2014), Scaffold for growing dense polymer brushes from a versatile substrate, ACS Applied Materials and Interfaces, 6 (4), 3648-3653
518	Masuda, K., Matsune, H., Takenaka, S. and Kishida, M. (2014), Synthesis of silica-coated AgCl nanoparticles in aqueous poly(vinylpyrrolidone) solution, Bulletin of the Chemical Society of Japan, 87 (4), 573-575
519	Norizoe, Y., Jinnai, H. and Takahara, A. (2014), Two-dimensional percolation phenomena of single-component linear homopolymer brushes, Journal of Chemical Physics, 140,054904
520	Murakami, D., Jinnai, H., Takahara, A. (2014), Wetting transition from the cassie-baxter state to the wenzel state on textured polymer surfaces, Langmuir, 30 (8), 2061-2067
521	Authors of Document Slodczyk, A., Sharp, M.D., Upasen, S., Colomban, P. and Kilner, J.A. (2014), Combined bulk and surface analysis of the $BaCe_{0.5}Zr_{0.3}Y_{0.16}Zn_{0.04}O_{3-\delta}$ (BCZYZ) ceramic proton-conducting electrolyte, Solid State Ionics, 262, 870-874
522	Chang, Y.H., Nakajima, Y., Tanaka, H., Yoshizawa, K. and Ozawa, F. (2014), Mechanism of N-H Bond Cleavage of Aniline by a Dearomatized PNP-Pincer Type Phosphaalkene Complex of Iridium(I), Organometallics, 33 (3), 715-721
523	He, H., Adzima, B., Zhong, M., Averick, S., Koepsel, R., Murata, H., Russell, A., Luebke, D., Takahara, A., Nulwala, H. and Matyjaszewski, K. (2014), Multifunctional photo-crosslinked polymeric ionic hydrogel films, Polymer Chemistry, 5 (8), 2824-2835
524	Wong, M., Ishige, R., Hoshino, T., Hawkins, S., Li, P., Takahara, A. and Sue, H.-J. (2014), Solution processable iridescent self-assembled nanoplatelets with finely tunable interlayer distances using charge- and sterically stabilizing oligomeric polyoxyalkyleneamine surfactants, Chemistry of Materials, 26 (4), 1528-1537
525	Xu, R., Karthik, J., Damodaran, A.R. and Martin, L.W. (2014), Stationary domain wall contribution to enhanced ferroelectric susceptibility, Nature Communications, 5, 3120
526	Asano, K., Kim, H., Sakaki, K., Page, K., Hayashi, S., Nakamura, Y. and Akiba, E. (2014), Synthesis and structural study of Ti-rich Mg-Ti hydrides, Journal of Alloys and Compounds, 593 (25), 132-136

527	Tsujimoto, Y., Satoh, K., Sugimori, H., Jinnai, H. and Kamigaito, M. (2014), Synthesis of titanium-containing block, random, end-functionalized, and junction-functionalized polymers via ruthenium-catalyzed living radical polymerization and direct observation of titanium domains by electron microscopy, Macromolecules, 47 (3), 944-953
528	Murakami, T., Sakai, N., Yamaguchi, T., Yarimitsu, S., Nakashima, K., Sawae, Y. and Suzuki, A. (2015), Evaluation of a superior lubrication mechanism with biphasic hydrogels for artificial cartilage, Tribology International, 89, 19-26
529	Somerday, B.P. and Barney, M. (2015), Measurement of Fatigue Crack Growth Relationships in Hydrogen Gas for Pressure Swing Adsorber Vessel Steels, Transactions of the ASME: Journal of Pressure Vessel Technology, 137 (2), 021406/1- 021406/7
530	Raja, S.N., Basu, S., Limaye, A.M., Anderson, T.J., Hyland, C.M., Lin, L., Alivisatos, A.P. and Ritchie, R.O. (2015), Strain-dependent dynamic mechanical properties of Kevlar to failure: Structural correlations and comparisons to other polymers, Materials Today Communications, 2, e33- e37
531	Cui, B., McMurtrey, M.D., Was, G.S. and Robertson, I.M. (2014), Micromechanistic origin of irradiation-assisted stress corrosion cracking, Philosophical Magazine, 94 (36), 4197-4218
532	Wegst, U.G.K., Bai, H., Saiz, E., Tomsia, A.P. and Ritchie, R.O. (2015), Bioinspired structural materials, Nature Materials, 14, 23-36
533	Ritchie, R.O. (2014), In pursuit of damage tolerance in engineering and biological materials, MRS Bulletin, 39 (10), 880-890
534	Li, Y.J., Kostka, A., Choi, P., Goto, S., Ponge, D., Kirchheim, R. and Raabe, D. (2015), Mechanisms of subgrain coarsening and its effect on the mechanical properties of carbon-supersaturated nanocrystalline hypereutectoid steel, Acta Materialia, 84, 110-123
535	Hamada, S., Fujisawa, T., Koyama, M., Koga, N., Nakada, N., Tsuchiyama, T., Ueda, M. and Noguchi, H. (2014), Strain mapping with high spatial resolution across a wide observation range by digital image correlation on plastic replicas, Materials Characterization, 98, 140-146
536	Gludovatz, B., Hohenwarter, A., Catoor, D., Chang, E.H., George, E.P. and Ritchie, R.O. (2014), A fracture-resistant high-entropy alloy for cryogenic applications, Science, 345 (6201), 1153-1158
537	Eftink, B.P., Mara, N.A., Kingstedt, O.T., Safarik, D.J., Lambros, J. and Robertson, I.M. (2014), Anomalous deformation twinning in coarse-grained Cu in $Ag_{60}Cu_{40}$ composites under high strain-rate compressive loading, Materials Science and Engineering A, 618, 254-261
538	Fujikawa, M., Maeda, N., Yamabe, J., Kodama, Y. and Koishi, M. (2014), Determining Stress–Strain in Rubber with In-Plane Biaxial Tensile Tester, Experimental Mechanics, 54 (9), 1639-1649
539	Li, Y., Raabe, D., Herbig, M., Choi, P.-P., Goto, S., Kostka, A., Yarita, H., Borchers, C. and Kirchheim, R. (2014), Segregation stabilizes nanocrystalline bulk steel with near theoretical strength, Physical Review Letters, 113 (10), 106104
540	Tanaka, M., Onomoto, T., Furusho, C., Tsuchiyama, T. and Higashida, K. (2014), Decrease in the Brittle-to-ductile Transition Temperature in Cu Added Nickel-free Austenitic Stainless Steels, ISIJ International, 54 (7), 1735-1740
541	Zimmermann, E.A., Köhne, T., Bale, H.A., Panganiban, B., Gludovatz, B., Zustind, J., Hahn, M. Amling, M., Ritchie, R.O. and Busse, B. (2015), Modifications to Nano- and Microstructural Quality and the Effects on Mechanical Integrity in Paget's Disease of Bone, Journal of Bone and Mineral Research, 30 (2), 264-273
542	Haboub, A., Bale, H.A., Nasiatka, J.R., Cox, B.N., Marshall, D.B., Ritchie, R.O., and MacDowell, A.A. (2014), Tensile testing of materials at high temperatures above 1700 ◦C with in situ synchrotron X-ray micro-tomography, Review of Scientific Instruments, 85 (8), 083702
543	Carriero, A., Zimmermann, E.A., Shefelbine, S.J. and Ritchie, R.O. (2014), A methodology for the investigation of toughness and crack propagation in mouse bone, Journal of the Mechanical Behavior of Biomedical Materials, 39, 38-47
544	Amugongo, S.K., Yao, W., Jia, J., Dai, W., Lay, Y.A.E., Jiang, L., Harvey, D., Zimmermann, E.A., Schaible, E., Dave, N., Ritchie, R.O., Kimmel, D.B. and Lane, N.E. (2014), Effect of sequential treatments with alendronate, parathyroid hormone (1-34) and raloxifene on cortical bone mass and strength in ovariectomized rats, Bone, 67, 257-268
545	Lawrence, S.K., Somerday, B.P., Moody, N.R., Bahr, D.F. (2014), Grain Boundary Contributions to Hydrogen-Affected Plasticity in Ni-201, JOM, 66 (8), 1383-1389
546	Cox, B.N., Bale, H.A., Begley, M., Blacklock, M., Do, B.-C., Fast, T., Naderi, M., Novak, M., Rajan, V.P., Rinaldi, R.G., Ritchie, R.O., Rossol, M.N., Shaw, J.H., Sudre, O., Yang, Q., Zok, F.W. and Marshall, D.B. (2014), Stochastic virtual tests for high-temperature ceramic matrix composites, Annual Review of Materials Research, 44, 479-529

547	Hata, S., Sato, K., Murayama, M., Tsuchiyama, T., and Nakashima, H. (2014), An experimental protocol development of three-dimensional transmission electron microscopy methods for ferrous alloys: Towards quantitative microstructural characterization in three dimensions, Tetsu-To-Hagane/Journal of the Iron and Steel Institute of Japan, 100 (7), 889-896
548	Sirithanakorn, T., Tanaka, M. and Higashida, K. (2014), Brittle-to-ductile transitions and its relation to the deformability of cementite in fully pearlitic steels, Materials Science and Engineering A, 611, 383-387
549	Kacher, J., Eftink, B.P., Cui, B. and Robertson, I.M. (2014), Dislocation interactions with grain boundaries, Current Opinion in Solid State and Materials Science, 18 (4), 227-243
550	Yang, W., Sherman, V.R., Gludovatz, B., Mackey, M., Zimmermann, E.A., Chang, E.H., Schaible, E., Qin, Z., Buehler, M.J., Ritchie, R.O. and Meyers, M.A. (2014), Protective role of Arapaima gigas fish scales: Structure and mechanical behavior, Acta Biomaterialia, 10 (8), 3599-3614
551	Sawae, Y. (2014), Tribology on prosthetic polymer materials, Kobunshi, 63 (5), 285-287
552	San Marchi, C., Somerday, B.P. and Nibur, K.A. (2014), Development of methods for evaluating hydrogen compatibility and suitability, International Journal of Hydrogen Energy, 39 (35), 20434-20439
553	Amugongo, S.K., Yao, W., Jia, J., Lay, Y.-A.E., Dai, W., Jiang, L., Walsh, D., Li, C.-S., Dave, N.K.N., Olivera, D., Panganiban, B., Ritchie, R.O. and Lane, N.E. (2014), Effects of sequential osteoporosis treatments on trabecular bone in adult rats with low bone mass, Osteoporosis International, 25 (6), 1735-1750
554	Zimmermann, E.A., Gludovatz, B., Schaible, E., Busse, B. and Ritchie, R.O. (2014), Fracture resistance of human cortical bone across multiple length-scales at physiological strain rates, Biomaterials, 35 (21), 5472-5481
555	Hughes, L.A., Somerday, B.P., Balch, D.K. and San Marchi, C. (2014), Hydrogen compatibility of austenitic stainless steel tubing and orbital tube welds, International Journal of Hydrogen Energy, 39 (35), 20585-20590
556	Ritchie, R. O. (2014), NATURAL MATERIALS Armoured oyster shells, Nature Materials, 13 (5), 435-437
557	Al-Kassab, T., Kompatscher, M., Kirchheim, R., Kostorz, G., Schönfeld, B. (2014), Phase decomposition and ordering in Ni-11.3 at.% Ti studied with atom probe tomography, Micron, 64, 45-51
558	Genet, M., Couégnat, G., Tomsia, A.P. and Ritchie, R.O. (2014), Scaling strength distributions in quasi-brittle materials from micro- to macro-scales: A computational approach to modeling Nature-inspired structural ceramics, Journal of the Mechanics and Physics of Solids, 68 (1), 93-106
559	Murakami, T., Yarimitsu, S., Nakashima, K., Yamaguchi, T., Sawae, Y., Sakai, N. and Suzuki, A. (2014), Superior lubricity in articular cartilage and artificial hydrogel cartilage, Proceedings of the Institution of Mechanical Engineers, Part J: Journal of Engineering Tribology, 228 (10), 1099-1111
560	Gludovatz, B., Naleway, S.E., Ritchie, R.O. and Kruzic, J.J. (2014), Size-dependent fracture toughness of bulk metallic glasses, Acta Materialia, 70, 198-207
561	Fukunaga, T., Kaneko, K., Kawano, R., Ueda, K., Yamada, K., Nakada, N., Kikuchi, M., Barnard, J.S. and Midgley, P.A. (2014), Formation of intergranular $M_{23}C_6$ in sensitized type-347 stainless steel, ISIJ International, 54 (1), 148-152
562	Tanaka, M., Fujii, A., Noguchi, H. and Higashida, K. (2014), Thermally activated processes of fatigue crack growth in steels, Philosophical Magazine Letters, 94 (2), 95-102
563	Shimokawa, T., Oguro, T., Tanaka, M., Higashida, K. and Ohashi, T. (2014), A multiscale approach for the deformation mechanism in pearlite microstructure: Atomistic study of the role of the heterointerface on ductility, Materials Science and Engineering A, 598, 68-76
564	Carriero, A., Zimmermann, E.A., Paluszny, A., Tang, S.Y., Bale, H., Busse, B., Alliston, T., Kazakia, G., Ritchie, R.O., and Shefelbine, S.J. (2014), How Tough Is Brittle Bone? Investigating Osteogenesis Imperfecta in Mouse Bone, Journal of Bone and Mineral Research, 29 (6), 1392-1401
565	Kacher, J and Robertson, I.M. (2014), In situ and tomographic analysis of dislocation/grain boundary interactions in alpha-titanium, Philosophical Magazine, 94 (8), 814-829
566	McMurtrey, M.D., Was, G.S., Cui, B., Robertson, I., Smith, L. and Farkas, D. (2014), Strain localization at dislocation channel-grain boundary intersections in irradiated stainless steel, International Journal of Plasticity, 56, 219-231
567	Wu, H.-L., Huff, L.A. and Gewirth, A.A. (2015), In situ raman spectroscopy of sulfur speciation in lithium-sulfur batteries, ACS Applied Materials and Interfaces, 7 (3), 1709-1719

568	Shigeta, M., Endo, T., Kondo, Y., Uejima, M., Okada, S., Kaneko, K. and Nakashima, N. (2014), Latex polymer/super growth-single-walled carbon nanotube composites with high electroconductivity fabricated by wet processing, Bulletin of the Chemical Society of Japan, 87 (12), 1343-1348
569	Barile, C.J., Barile, E.C., Zavadil, K.R., Nuzzo, R.G. and Gewirth, A.A. (2014), Electrolytic conditioning of a magnesium aluminum chloride complex for reversible magnesium deposition, Journal of Physical Chemistry C, 118 (48), 27623-27630
570	Jung, F.L.W., Kim, F.L.J.J. and Tuller, F.L.H.L (2015), Investigation of nanoporous platinum thin films fabricated by reactive sputtering: Application as micro-SOFC electrode, Journal of Power Sources, 275, 860-865
571	Bauer, U., Yao, L., Tan, A.J., Agrawal, P., Emori, S., Tuller, H.L., van Dijken, S. and Beach, G.S.D. (2015), Magneto-ionic control of interfacial magnetism, Nature Materials, 14, 174-181
572	Hoang, T.T.H., Cohen, Y. and Gewirth, A.A. (2014), In situ electrochemical stress measurements examining the oxygen evolution reaction in basic electrolytes, Analytical Chemistry, 86 (22), 11290-11297
573	Li, J., Shiraki, T., Hu, B., Wright, R.A.E., Zhao, B. and Moore, J.S. (2014), Mechanophore activation at heterointerfaces, Journal of the American Chemical Society, 136 (45), 15925-15928
574	Ma, W., Kim, J.J., Tsvetkov, N., Daio, T., Kuru, Y., Cai, Z., Chen, Y., Sasaki, K., Tuller, H.L. and Yildiz, B. (2015), Vertically aligned nanocomposite $La_{0.8}Sr_{0.2}CoO_3/(La_{0.5}Sr_{0.5})_2CoO_4$ cathodes-electronic structure, surface chemistry and oxygen reduction kinetics, Journal of Materials Chemistry A, 3 (1), 207-219
575	Jaber-Ansari, L., Puntambekar, K.P., Tavassol, H., Yildirim, H., Kinaci, A., Kumar, R., Saldaña, S.J., Gewirth, A.A., Greeley, J.P., Chan, M.K.Y. and Hersam, M.C. (2014), Defect evolution in graphene upon electrochemical lithiation, ACS Applied Materials and Interfaces, 6 (20), 17626-17636
576	Messerschmitt, F., Kubicek, M., Schweiger, S. and Rupp, J.L.M. (2014), Memristor kinetics and diffusion characteristics for mixed anionic-electronic $SrTiO_{3-\delta}$ bits: The memristor-based cottrell analysis connecting material to device performance, Advanced Functional Materials, 24 (47), 7448-7460
577	Chen, D., Cao, Y., Weng, D. and Tuller, H.L. (2014), Defect and transport model of ceria-zirconia solid solutions: $Ce_{0.8}Zr_{0.2}O_{2-\delta}$-an electrical conductivity study, Chemistry of Materials, 26 (17), 5143-5150
578	Sada, T., Fujigaya, T. and Nakashima, N. (2014), Design and fabrication of Ni nanowires having periodically hollow nanostructures, Nanoscale, 6 (19), 11484-11488
579	Tavassol, H., Cason, M.W., Nuzzo, R.G. and Gewirth, A.A. (2015), Influence of oxides on the stress evolution and reversibility during SnO_x conversion and Li-Sn alloying reactions, Advanced Energy Materials, 5 (1), 1400317
580	Imato, K., Ohishi, T., Nishihara, M., Takahara, A. and Otsuka, H. (2014), Network reorganization of dynamic covalent polymer gels with exchangeable diarylbibenzofuranone at ambient temperature, Journal of the American Chemical Society, 136 (33), 11839-11845
581	Erickson, E.M., Oruc, M.E., Wetzel, D.J., Cason, M.W., Hoang, T.T.H., Small, M.W., Li, D., Frenkel, A.I., Gewirth, A.A. and Nuzzo, R.G. (2014), A comparison of atomistic and continuum approaches to the study of bonding dynamics in electrocatalysis: Microcantilever stress and in situ EXAFS observations of platinum bond expansion due to oxygen adsorption during the oxygen reduction reaction, Analytical Chemistry, 86 (16), 8368-8375
582	Huff, L.A., Rapp, J.L., Baughman, J.A., Rinaldi, P.L. and Gewirth, A.A. (2015), Identification of lithium-sulfur battery discharge products through ^{6}Li and ^{33}S solid-state MAS and ^{7}Li solution NMR spectroscopy, Surface Science, 631, 295-300
583	Schmitt, K.G. and Gewirth, A.A. (2014), In situ surface-enhanced raman spectroscopy of the electrochemical reduction of carbon dioxide on silver with 3,5-diamino-1,2,4-triazole, Journal of Physical Chemistry C, 118 (31), 17567-17576
584	Kim, I.D., Avrahami, Y., Socci, L., Royo, F.L. and Tuller, H.L. (2014), Ridge Waveguide Using Highly Oriented $BaTiO_3$ Thin Films For Electro-Optic Application, Journal of Asian Ceramic Societies, 2 (3), 231-234
585	Renugopalakrishnan, V., Barbiellini, B., King, C., Molinari, M., Mochalov, K., Sukhanova, A., Nabiev, I., Fojan, P., Tuller, H.L., Chin, M., Somasundaran, P., Padrós, E. and Ramakrishna, S. (2014), Engineering a robust photovoltaic device with quantum dots and bacteriorhodopsin, Journal of Physical Chemistry C, 118 (30), 16710-16717
586	Choi, S.-J., Fuchs, F., Demadrille, R., Grévin, B., Jang, B.-H., Lee, S.-J., Lee, J.-H., Tuller, H.L. and Kim, I.-D. (2014), Fast responding exhaled-breath sensors using WO_3 hemitubes functionalized by graphene-based electronic sensitizers for diagnosis of diseases, ACS Applied Materials and Interfaces, 6 (12), 9061-9070

587	Nishihama, S., Matsunaga, S., Takayama, S., Ookubo, T., Yoshizuka, K., Fujigaya, T. and Nakashima, N. (2014), Thermal-swing adsorption of europium(III) with poly(*N*-isopropylacrylamide) combined with an acidic extractant, Solvent Extraction Research and Development, 21 (1), 37-45
588	Schweiger, S., Kubicek, M., Messerschmitt, F., Murer, C. and Rupp, J.L.M. (2014), A microdot multilayer oxide device: Let us tune the strain-ionic transport interaction, ACS Nano, 8 (5), 5032-5048
589	Zhang, Y., Kim, J.J., Chen, D., Tuller, H.L. and Rutledge, G.C. (2014), Electrospun polyaniline fibers as highly sensitive room temperature chemiresistive sensors for ammonia and nitrogen dioxide gases, Advanced Functional Materials, 24 (25), 4005-4014
590	Barile, C.J., Spatney, R., Zavadil, K.R. and Gewirth, A.A. (2014), Investigating the reversibility of in situ generated magnesium organohaloaluminates for magnesium deposition and dissolution, Journal of Physical Chemistry C, 118 (20), 10694-10699
591	Engel, J. and Tuller, H.L. (2014), The electrical conductivity of thin film donor doped hematite: From insulator to semiconductor by defect modulation, Physical Chemistry Chemical Physics, 16 (23), 11374-11380
592	Gao, F., Chen, D., Tuller, H.L., Thompson, C.V. and Palacios, T. (2014), On the redox origin of surface trapping in AlGaN/GaN high electron mobility transistors, Journal of Applied Physics, 115 (12), 124506/1-124506/8
593	Chen, D., Groß, A., Bono, D.C., Kita, J., Moos, R. and Tuller, H.L. (2014), Electrical conductivity relaxation measurements: Application of low thermal mass heater stick, Solid State Ionics, 262, 914-917
594	Honesty, N.R., Kardaş, G. and Gewirth, A.A. (2014), Investigating Rhodanine film formation on roughened Cu surfaces with electrochemical impedance spectroscopy and surface-enhanced Raman scattering spectroscopy, Corrosion Science, 83, 59-66
595	Choi, S.-H., Jang, B.-H., Park, J.-S., Demadrille, R., Tuller, H.L. and Kim, I.-D. (2014), Low voltage operating field effect transistors with composite In_2O_3-ZnO-$ZnGa_2O_4$ nanofiber network as active channel layer, ACS Nano, 8 (3), 2318-2327
596	Luckyanova, M.N., Chen, D., Ma, W., Tuller, H.L., Chen, G. and Yildiz, B. (2014), Thermal conductivity control by oxygen defect concentration modification in reducible oxides: The case of $Pr_{0.1}Ce_{0.9}O_{2-\delta}$ thin films, Applied Physics Letters, 104 (6), 061911/1-061911/4
597	Swallow, J., Woodford, W., Chen, Y., Lu, Q., Kim, J. J., Chen, D., Chiang, Y. M., Carter, W. C., Yildiz, B., Tuller, H., and Van Vliet, K. J. (2014), Chemomechanics of Ionically Conductive Ceramics for Electrical Energy Conversion and Storage, Journal of Electroceramics, 32 (1), 3-27
598	Esbenshade, J.L. and Gewirth, A.A. (2014), Effect of mn and cu addition on lithiation and sei formation on model anode electrodes, Journal of the Electrochemical Society, 161 (4), A513-A518
599	Fister, T.T., Esbenshade, J., Chen, X., Long, B.R., Shi, B., Schlepütz, C.M., Gewirth, A.A., Bedzyk, M.J. and Fenter, P. (2014), Lithium intercalation behavior in multilayer silicon electrodes, Advanced Energy Materials, 4 (7), 1301494
600	Wang, J.-L., He, S.-S., Bao, J.-J., Zhang, X., Yang, J.-K. and Chen, Y.-F. (2014), Characterization of Thermal Transport in Carbon Nanotube Yarns, International Journal of Micro-Nano Scale Transport, 5 (2), 59-68
601	Choi, G.-M. and Cahill, D.G. (2014), Kerr rotation in Cu, Ag, and Au driven by spin accumulation and spin-orbit coupling, Physical Review B - Condensed Matter and Materials Physics, 90 (21), 214432
602	Liu, J.-H., Wang, H.-D., Hu, Y.-D., Ma, W.-G. and Zhang, X. (2015), Laser flash-Raman spectroscopy method for the measurement of the thermal properties of micro/nano wires, Review of Scientific Instruments, 86 (1), 014901
603	Liu, J., Choi, G.-M. and Cahill, D.G. (2014), Measurement of the anisotropic thermal conductivity of molybdenum disulfide by the time-resolved magneto-optic Kerr effect, Journal of Applied Physics, 116 (23), 233107
604	Schinwald, A., Murphy, F., Askounis, A., Koutsos, V., Sefiane, K., Donaldson, K. and Campbell, C.J. (2014), Minimal oxidation and inflammogenicity of pristine graphene with residence in the lung, Nanotoxicology, 8 (8), 824-832
605	Wang, H.-D., Liu, J.-H., Zhang, X., Zhang, R.-F and Wei, F (2015), Raman Measurement of Heat Transfer in Suspended Individual Carbon Nanotube, Journal of Nanoscience and Nanotechnology, 15 (4), 2939-2943
606	Song, M.X., Chen, K., Zhang, X. and Wang, J. (2015), The lazy greedy algorithm for power optimization of wind turbine positioning on complex terrain, Energy, 80, 567-574

607	Kimling, J., Kimling, J., Wilson, R.B., Hebler, B., Albrecht, M. and Cahill, D.G. (2014), Ultrafast demagnetization of FePt:Cu thin films and the role of magnetic heat capacity, Physical Review B - Condensed Matter and Materials Physics, 90 (22), 224408
608	Koh, Y.K., Cahill, D.G. and Sun, B. (2014), Nonlocal theory for heat transport at high frequencies, Physical Review B - Condensed Matter and Materials Physics, 90 (20), 205412
609	Gunning, N.S., Feser, J., Falmbigl, M., Beekman, M., Cahill, D.G. and Johnson, D.C. (2014), Synthesis, structure, and thermal conductivity of $[(SnSe)_{1+y}]_n[MoSe_2]_n$ compounds, Semiconductor Science and Technology, 29 (12), 124007
610	Chen, K., Song, M.X. and Zhang, X. (2014), Binary-real coding genetic algorithm for wind turbine positioning in wind farm, Journal of Renewable and Sustainable Energy, 6,053115
611	Feser, J.P., Liu, J. and Cahill, D.G. (2014), Pump-probe measurements of the thermal conductivity tensor for materials lacking in-plane symmetry, Review of Scientific Instruments, 85 (10), 104903
612	Tong, T., Karthik, J., Martin, L.W. and Cahill, D.G. (2014), Secondary effects in wide frequency range measurements of the pyroelectric coefficient of $Ba_{0.6}Sr_{0.4}TiO_3$ and $PbZr_{0.2}Ti_{0.8}O_3$ epitaxial layers, Physical Review B - Condensed Matter and Materials Physics, 90 (15), 155423
613	Tong, T., Karthik, J., Mangalam, R.V.K., Martin, L.W. and Cahill, D.G. (2014), Reduction of the electrocaloric entropy change of ferroelectric $PbZr_{1-x}Ti_xO_3$ epitaxial layers due to an elastocaloric effect, Physical Review B - Condensed Matter and Materials Physics, 90 (9), 094116
614	Mai, C.-K., Schlitz, R.A., Su, G.M., Spitzer, D., Wang, X., Fronk, S.L., Cahill, D.G., Chabinyc, M.L. and Bazan, G.C. (2014), Side-chain effects on the conductivity, morphology, and thermoelectric properties of self-doped narrow-band-gap conjugated polyelectrolytes, Journal of the American Chemical Society, 136 (39), 13478-13481
615	Li, Q.-Y., Chen, Q. and Zhang, X. (2014), CO_2 long-term diffusive leakage into biosphere in geological carbon storage, Chinese Science Bulletin, 59 (28), 3686-3690
616	Alkhair, M., Sulaiman, M.Y., Sopian, K., Lim, C.H., Salleh, E., Mat, S. and Saha, B.B. (2015), Design and Modeling of One Refrigeration Ton Solar Assisted Adsorption Air Conditioning System, Journal of Solar Energy Engineering, 137 (1), 011005
617	Böttger, P.H.M., Braginsky, L., Shklover, V., Lewin, E., Patscheider, J., Cahill, D.G. and Sobiech, M. (2014), Hard wear-resistant coatings with anisotropic thermal conductivity for high thermal load applications, Journal of Applied Physics, 116 (1), 013507
618	Buongiorno, J., Cahill, D.G., Hidrovo, C.H., Moghaddam, S., Schmidt, A.J. and Shi, L. (2014), Micro-and nanoscale measurement methods for phase change heat transfer on planar and structured surfaces, Nanoscale and Microscale Thermophysical Engineering, 18 (3), 270-287
619	Choi, G.-M., Min, B.-C., Lee, K.-J. and Cahill, D.G. (2014), Spin current generated by thermally driven ultrafast demagnetization, Nature Communications, 5, 4334
620	El-Sharkawy, I., Sherif, S.M., Jones, B., Mila, I., Kumar, P.P., Bouzayen, M. and Jayasankar, S. (2014), TIR1-like auxin-receptors are involved in the regulation of plum fruit development, Journal of Experimental Botany, 65 (18), 5205-5215
621	Sasikumar, K., Liang, Z., Cahill, D.G. and Keblinski, P. (2014), Curvature induced phase stability of an intensely heated liquid, Journal of Chemical Physics, 140 (23), 234506
622	Park, J.Y., Gardner, A., King, W.P. and Cahill, D.G. (2014), Droplet impingement and vapor layer formation on hot hydrophobic surfaces, Journal of Heat Transfer, 136 (9), 092902
623	Mei, A.B., Wilson, R.B., Li, D., Cahill, D.G., Rockett, A., Birch, J., Hultman, L., Greene, J.E. and Petrov, I. (2014), Elastic constants, Poisson ratios, and the elastic anisotropy of VN(001), (011), and (111) epitaxial layers grown by reactive magnetron sputter deposition, Journal of Applied Physics, 115 (21), 214908
624	Chen, K., Song, M.X. and Zhang, X. (2014), The iteration method for tower height matching in wind farm design, Journal of Wind Engineering and Industrial Aerodynamics, 132, 37-48
625	Jia, L., Ma., W. and Zhang, X. (2014), Ultrafast carrier dynamics in polycrystalline bismuth telluride nanofilm, Applied Physics Letters, 104, 241911
626	Sanna, A., Hutter, C., Kenning, D.B.R., Karayiannis, T.G., Sefiane, K. and Nelson, R.A. (2014), Numerical investigation of nucleate boiling heat transfer on thin substrates, International Journal of Heat and Mass Transfer, 76, 45-64
627	Chen, K., Song, M. and Zhang, X. (2014), The investigation on computational grids in wind turbine positioning optimization using greedy algorithm, Chinese Science Bulletin, 59 (26), 3304-3313
628	Najar, H., Chan, M.-L., Yang, H.-A., Lin, L., Cahill, D.G., Horsley, D.A. (2014), High quality factor nanocrystalline diamond micromechanical resonators limited by thermoelastic damping, Applied Physics Letters, 104 (15), 151903
629	Shahzad, M.W., Ng, K.C., Thu, K., Saha, B.B. and Chun, W.G. (2014), Multi effect desalination and adsorption desalination (MEDAD): A hybrid desalination method, Applied Thermal Engineering, 72

630	Wang, X.J., Mori, T., Kuzmych-Ianchuk, I., Michiue, Y., Yubuta, K., Shishido, T., Grin, Y., Okada, S. and Cahill, D.G. (2014), Thermal conductivity of layered borides: The effect of building defects on the thermal conductivity of TmAlB4 and the anisotropic thermal conductivity of AlB2, APL Materials, 2 (4), 046113
631	Grimm, D., Wilson, R.B., Teshome, B., Gorantla, S., Rümmeli, M.H., Bublat, T., Zallo, E., Li, G., Cahill, D.G. and Schmidt, O.G. (2014), Thermal conductivity of mechanically joined semiconducting/metal nanomembrane superlattices, Nano Letters, 14 (5), 2387-2393
632	Choi, G.-M. , Wilson, R.B. and Cahill, D.G. (2014), Indirect heating of Pt by short-pulse laser irradiation of Au in a nanoscale Pt/Au bilayer, Physical Review B - Condensed Matter and Materials Physics, 89 (6), 064307
633	Song, M.X., Chen, K., He, Z.Y. and Zhang, X. (2014), Optimization of wind farm micro-siting for complex terrain using greedy algorithm, Energy, 67, 454-459
634	Chen, K., Song, M.X. and Zhang, X. (2014), The random walking method for the steady linear convection diffusion equation with axisymmetric disc boundary, Science China Technological Sciences, 57 (4), 804-810
635	Akasaka, R., Higashi, Y., Miyara, A. and Koyama, S. (2014), A fundamental equation of state for cis-1,3,3,3-tetrafluoropropene (R-1234ze(Z)), International Journal of Refrigeration, 44, 168-176
636	Zhu, J.J., Li, Z. and Zhang, X. (2014), Experimental studies on overall property of thermoelectric modules with sandwiched structures, Chinese Science Bulletin, 59 (5-6), 571-576
637	Hohensee, G.T., Wilson, R.B., Feser, J.P. and Cahill, D.G. (2014), Magnon-phonon coupling in the spin-ladder compound $Ca_9La_5Cu_{24}O_{41}$ measured by time-domain thermoreflectance, Physical Review B - Condensed Matter and Materials Physics, 89 (2), 024422
638	Seto, T., Inoue, A., Higashi, H., Ohtani, Y., Kohno, M. and Hirasawa, M. (2014), Phase transition and restructuring of carbon nanoparticles induced by aerosol laser irradiation, Carbon, 70, 224-232
639	Huang, J., Wang, W., Murphy, C.J. and Cahill, D.G. (2014), Resonant secondary light emission from Plasmonic Au nanostructures at high electron temperatures created by pulsed-laser excitation, Proceedings of the National Academy of Sciences of the United States of America, 111 (3), 906-911
640	Wu, B., Song, M., Chen, K., He, Z. and Zhang, X. (2014), Wind power prediction system for wind farm based on auto regressive statistical model and physical model, Journal of Renewable and Sustainable Energy, 6 (1), 013101
641	Chang, F., Guo, J., Wu, G., Liu, L., Zhang, M., He, T., Wang, P., Yu, P. and Chen, P. (2015), Covalent triazine-based framework as an efficient catalyst support for ammonia decomposition, RSC Advances, 5 (5), 3605-3610
642	Chen, W.D., Huang, Z.G., Wu, G.T. and Chen, P. (2015), New synthetic procedure for $NaNH_2(BH_3)_2$ and evaluation of its hydrogen storage properties, Science China Chemistry, 58 (1), 169-173
643	Liu, L., Wu, G., Chen, W., Xiong, Z., He, T. and Chen, P. (2015), Synthesis and hydrogen storage properties of lithium borohydride urea complex, International Journal of Hydrogen Energy, 40 (1), 429-434
644	Chen, J., Chua, Y.S., Wu, H., Xiong, Z., He, T., Zhou, W., Ju, X., Yang, M., Wu, G. and Chen, P. (2015), Synthesis, structures and dehydrogenation of magnesium borohydride-ethylenediamine composites, International Journal of Hydrogen Energy, 40 (1), 412-419
645	Liu, L., Zhang, M., Xiong, Z., Hu, D., Wu, G. and Chen, P. (2015), Ammonia borane assisted solid exfoliation of graphite fluoride for facile preparation of fluorinated graphene nanosheets, Carbon, 81 (1), 702-709
646	Cao, H., Wu, G., Zhang, Y., Xiong, Z., Qiu, J. and Chen, P. (2014), Effective thermodynamic alteration to $Mg(NH_2)_2$/LiH system: Achieving near ambient-temperature hydrogen storage, Journal of Materials Chemistry A, 2 (38), 15816-15822
647	Chen, J., Wu, G., Xiong, Z., Wu, H., Chua, Y.S., Zhou, W., Liu, B. Ju, X. and Chen, P. (2014), Synthesis, thermal behavior, and dehydrogenation kinetics study of lithiated ethylenediamine, Chemistry - A European Journal, 20 (42), 13636-13643
648	Yu, P., Chua, Y.S., Cao, H., Xiong, Z., Wu, G. and Chen, P. (2014), Hydrogen storage over alkali metal hydride and alkali metal hydroxide composites, Journal of Energy Chemistry, 23 (4), 414-419
649	Cao, H., Wang, H., He, T., Wu, G., Xiong, Z., Qiu, J. and Chen, P. (2014), Improved kinetics of the $Mg(NH_2)_2$-2LiH system by addition of lithium halides, RSC Advances, 4 (61), 32555-32561
650	Chen, J., He, T., Wu, G., Xiong, Z., Liu, L., Ju, X. and Chen, P. (2014), Lithium borohydride ethylenediaminates: A case study of solid-state $LiBH_4$-organic amine complexes, Journal of Physical Chemistry C, 118 (25), 13451-13459

651	Chua, Y.S., Pei, Q., Ju, X., Zhou, W., Udovic, T.J., Wu, G., Xiong, Z., Chen, P. and Wu, H. (2014), Alkali metal hydride modification on hydrazine borane for improved dehydrogenation, Journal of Physical Chemistry C, 118 (21), 11244-11251
652	Emami, H., Cuevas, F. and Latroche, M. (2014), Ti(Ni,Cu) pseudobinary compounds as efficient negative electrodes for NieMH batteries, Journal of Power Sources, 265, 182-191
653	Chen, J., Wu, H., Wu, G., Xiong, Z., Wang, R., Fan, H., Zhou, W., Liu, B., Chua, Y., Ju, X. and Chen, P. (2014), Lithiated primary amine - A new material for hydrogen storage, Chemistry - A European Journal, 20 (22), 6632-6635
654	Cao, H., Wang, J., Chua, Y., Wang, H., Wu, G., Xiong, Z., Qiu, J. and Chen, P. (2014), NH_3 mediated or ion migration reaction: The case study on halide-amide system, Journal of Physical Chemistry C, 118 (5), 2344-2349
655	Huynh, M.T., Wang, W., Rauchfuss, T.B. and Hammes-Schiffer, S. (2014), Computational investigation of [FeFe]-hydrogenase models: Characterization of singly and doubly protonated intermediates and mechanistic insights, Inorganic Chemistry, 53 (19), 10301-10311
656	Mitra, J., Zhou, X. and Rauchfuss, T. (2015), Pd/C-catalyzed reactions of HMF: Decarbonylation, hydrogenation, and hydrogenolysis, Green Chemistry, 17 (1), 307-313
657	Schilter, D., Pelmenschikov, V., Wang, H., Meier, F., Gee, L.B., Yoda, Y., Kaupp, M., Rauchfuss, T.B. and Cramer, S.P. (2014), Synthesis and vibrational spectroscopy of 57Fe-labeled models of [NiFe] hydrogenase: First direct observation of a nickel-iron interaction, Chemical Communications, 50 (88), 13469-13472
658	Huynh, M.T., Schilter, D., Hammes-Schiffer, S. and Rauchfuss, T.B. (2014), Protonation of nickel-iron hydrogenase models proceeds after isomerization at nickel, Journal of the American Chemical Society, 136 (35), 12385-12395
659	Manor, B.C., Ringenberg, M.R. and Rauchfuss, T.B. (2014), Borane-protected cyanides as surrogates of h-bonded cyanides in [FeFe]-hydrogenase active site models, Inorganic Chemistry, 53 (14), 7241-7247
660	Lin, T., Ulloa, O.A., Rauchfuss, T.B. and Gray, D.L. (2014), Diiron azamonothiolates by the scission of dithiadiazacyclooctanes by iron carbonyls, European Journal of Inorganic Chemistry, 2014 (25), 4109-4114
661	Lansing, J.C., Camara, J.M., Gray, D.E. and Rauchfuss, T.B. (2014), Hydrogen production catalyzed by bidirectional, biomimetic models of the [FeFe]-hydrogenase active site, Organometallics, 33 (20), 5897-5906
662	Tse, E.C.M., Schilter, D., Gray, D.L., Rauchfuss, T.B. and Gewirth, A.A. (2014), Multicopper models for the laccase active site: Effect of nuclearity on electrocatalytic oxygen reduction, Inorganic Chemistry, 53 (16), 8505-8516
663	Kitano, S., Tanaka, A., Hashimoto, K. and Kominami, H. (2014), Selective oxidation of alcohols in aqueous suspensions of rhodium ion-modified TiO_2 photocatalysts under irradiation of visible light, Physical Chemistry Chemical Physics, 16 (24), 12554-12559
664	Smith, D.P., Chen, H., Ogo, S., Elduque, A.I., Eisenstein, M., Olmstead, M.M. and Fish, R.H. (2014), Bioorganometallic Chemistry. 27. Synthetic, X-ray Crystallographic, and Competitive Binding Studies in the Reactions of Nucleobases, Nucleosides, and Nucleotides with $[Cp^*Rh(H_2O)_3](OTf)_2$, as a Function of pH, and the Utilization of Several Cp*Rh–DNA Base, Organometallics, 33 (10), 2389-2404
665	Zhou, X., Mitra, J. and Rauchfuss, T.B. (2014), Lignol cleavage by Pd/C under mild conditions and without hydrogen: A role for benzylic C=H activation?, ChemSusChem, 7 (6), 1623-1626
666	Wang, W., Rauchfuss, T.B., Zhu, L. and Zampella, G. (2014), New reactions of terminal hydrides on a diiron dithiolate, Journal of the American Chemical Society, 136 (15), 5773-5782
667	Chambers, G.M., Mitra, J., Rauchfuss, T.B. and Stein, M. (2014), Ni^{I}/Ru^{II} model for the Ni-L state of the [NiFe]hydrogenases: Synthesis, spectroscopy, and reactivity, Inorganic Chemistry, 53 (8), 4243-4249
668	Carroll, M.E., Chen, J., Gray, D.E., Lansing, J.C., Rauchfuss, T.B., Schilter, D., Volkers, P.I. and Wilson, S.R. (2014), Ferrous carbonyl dithiolates as precursors to FeFe, FeCo, and FeMn carbonyl dithiolates, Organometallics, 33 (4), 858-867
669	Kobayashi, A., Yamamoto, D., Horiki, H., Sawaguchi, K., Matsumoto, T., Nakajima, K., Chang, H.C. and Kato, M. (2014), Photoinduced Dimerization Reaction Coupled with Oxygenation of a Platinum(II)-Hydrazone Complex, Inorganic Chemistry, 53 (5), 2573-2581
670	Yagi, T., Ogo, S. and Higuchi, Y (2014), Catalytic cycle of cytochrome-c_3 hydrogenase, a [NiFe]-enzyme, deduced from the structures of the enzyme and the enzyme mimic, International Journal of Hydrogen Energy, 39 (32), 18543-18550
671	Robeson, L.M., Liu, Q., Freeman, B.D. and Paul, D.R. (2015), Comparison of transport properties of rubbery and glassy polymers and the relevance to the upper bound relationship, Journal of Membrane Science, 476, 421-431

672	Li, H., Whittenberg, J.J., Zhou, H., Ranganathan, D., Desai, A.V., Koziol, J., Zeng, D., Kenis, P.J.A. and Reichert, D.E. (2015), Development of a microfluidic “click chip” incorporating an immobilized Cu(I) catalyst, RSC Advances, 5 (8), 6142-6150
673	Perry, S.L., Guha, S., Pawate, A.S., Henning, R., Kosheleva, I., Srajer, V., Kenis, P.J.A. and Ren, Z. (2014), In situ serial Laue diffraction on a microfluidic crystallization device, Journal of Applied Crystallography, 47 (6), 1975-1982
674	Smith, Z.P., Czenkusch, K., Wi, S., Gleason, K.L., Hernández, G., Doherty, C.M., Konstas, K., Bastow, T.J., Álvarez, C., Hill, A.J., Lozano, A.E., Paul, D.R. and Freeman, B.D. (2014), Investigation of the chemical and morphological structure of thermally rearranged polymers, Polymer (United Kingdom), 55 (26), 6649-6657
675	Wu, K., Birgersson, E., Kim, B., Kenis, P.J.A. and Karimi, I.A. (2015), Modeling and experimental validation of electrochemical reduction of CO_2 to CO in a microfluidic cell, Journal of the Electrochemical Society, 162 (1), F23- F32
676	Tice, J.D., Desai, A.V., Bassett, T.A., Apblett, C.A. and Kenis, P.J.A. (2014), Control of pressure-driven components in integrated microfluidic devices using an on-chip electrostatic microvalve, RSC Advances, 4 (93), 51593-51602
677	Lan, Y., Ma, S., Kenis, P.J.A. and Lu, J. (2014), Hydrogen evolution in the presence of CO_2 in an aqueous solution during electrochemical reduction, International Journal of Electrochemical Science, 9 (12), 8097-8105
678	Galizia, M., Smith, Z.P., Sarti, G.C., Freeman, B.D. and Paul, D.R. (2015), Predictive calculation of hydrogen and helium solubility in glassy and rubbery polymers, Journal of Membrane Science, 475, 110-121
679	Gleason, K.L., Smith, Z.P., Liu, Q., Paul, D.R. and Freeman, B.D. (2015), Pure- and mixed-gas permeation of CO_2 and CH_4 in thermally rearranged polymers based on 3,3'-dihydroxy-4,4'-diamino-biphenyl (HAB) and 2,2'-bis-(3,4-dicarboxyphenyl) hexafluoropropane dianhydride (6FDA), Journal of Membrane Science, 475, 204-214
680	Tiwari, R.R., Smith, Z.P., Lin, H., Freeman, B.D. and Paul, D.R. (2014), Gas permeation in thin films of "high free-volume" glassy perfluoropolymers: Part I. Physical aging, Polymer (United Kingdom), 55 (22), 5788-5800
681	Ma, Y., Guan, G., Hao, X., Zuo, Z., Huang, W., Phanthong, P., Kusakabe, K. and Abudula, A. (2014), Highly-efficient steam reforming of methanol over copper modified molybdenum carbide, RSC Advances, 4 (83), 44175-44184
682	Kim, H.W., Yoon, H.W., Yoo, B.M., Park, J.S., Gleason, K.L., Freeman, B.D. and Park, H.B. (2014), High-performance CO_2-philic graphene oxide membranes under wet-conditions, Chemical Communications, 50 (88), 13563-13566
683	Lan, Y., Ma, S., Lu, J. and Kenis, P.J.A. (2014), Investigation of a Cu(core)/CuO(shell) catalyst for electrochemical reduction of CO_2 in aqueous soultion, International Journal of Electrochemical Science, 9 (12), 7300-7308
684	Sundell, B.J., Shaver, A.T., Liu, Q., Nebipasagil, A., Pisipati, P., Mecham, S.J., Riffle, J.S., Freeman, B.D. and McGrath, J.E. (2014), Synthesis, oxidation and crosslinking of tetramethyl bisphenol F (TMBPF)-based polymers for oxygen/nitrogen gas separations, Polymer (United Kingdom), 55 (22), 5623-5634
685	Kyritsis, D.C. (2014), An artificial neural network for data mining, Revista Tecnica de la Facultad de Ingenieria Universidad del Zulia, 37 (2), 65-73
686	Lan, Y.C., Gai, C., Kenis, P.J.A. and Lu, JX (2014), Electrochemical Reduction of Carbon Dioxide on Cu/CuO Core/Shell Catalysts, Chemelectrochem, 1 (9), 1577-1582
687	Khvostichenko, D.S., Schieferstein, J.M., Pawate, A.S., Laible, P.D. and Kenis, P.J.A. (2014), X-ray transparent microfluidic chip for mesophase-based crystallization of membrane proteins and on-chip structure determination, Crystal Growth and Design, 14 (10), 4886-4890
688	Lopez-Montesinos, P.O., Desai, A.V. and Kenis, P.J.A. (2014), A three-dimensional numerical model of a micro laminar flow fuel cell with a bridge-shaped microchannel cross-section, Journal of Power Sources, 269, 542-549
689	Korposh, S., Selyanchyn, R., James, S., Tatam, R. and Lee, S.-W. (2014), Identification and quality assessment of beverages using a long period grating fibre-optic sensor modified with a mesoporous thin film, Sensing and Bio-Sensing Research, 1, 26-33
690	Byrne, M.B., Trump, L., Desai, A.V., Schook, L.B., Gaskins, H.R. and Kenis, P.J.A. (2014), Microfluidic platform for the study of intercellular communication via soluble factor-cell and cell-cell paracrine signaling, Biomicrofluidics, 8 (4), 044104

691	Wu, K., Birgersson, E., Kenis, P.J.A. and Karimi, I.A. (2014), Modeling and simulating electrochemical reduction of CO_2 in a microfluidic cell, Computer Aided Chemical Engineering, 34, 639-644
692	Scholes, C.A., Freeman, B.D. and Kentish, S.E. (2014), Water vapor permeability and competitive sorption in thermally rearranged (TR) membranes, Journal of Membrane Science, 470, 132-137
693	Wiegand, J.R., Smith, Z.P., Liu, Q., Patterson, C.T., Freeman, B.D. and Guo, R. (2014), Synthesis and characterization of triptycene-based polyimides with tunable high fractional free volume for gas separation membranes, Journal of Materials Chemistry A, 2 (33), 13309-13320
694	Ma, Y., Guan, G., Phanthong, P., Hao, X., Huang, W., Tsutsumi, A., Kusakabe, K., Abudula, A. (2014), Catalytic activity and stability of nickel-modified molybdenum carbide catalysts for steam reforming of methanol, Journal of Physical Chemistry C, 118 (18), 9485-9496
695	Smith, Z.P., Tiwari, R.R., Dose, M.E., Gleason, K.L., Murphy, T.M., Sanders, D.F., Gunawan, G., Robeson, L.M., Paul, D.R. and Freeman, B.D. (2014), Influence of diffusivity and sorption on helium and hydrogen separations in hydrocarbon, silicon, and fluorocarbon-based polymers, Macromolecules, 47 (9), 3170-3184
696	Arena, J.T., Manickam, S.S., Reimund, K.K., Freeman, B.D. and McCutcheon, J.R. (2014), Solute and water transport in forward osmosis using polydopamine modified thin film composite membranes, Desalination, 343, 8-16
697	Li, H., Zhou, H., Krieger, S., Parry, J.J., Whittenberg, J.J., Desai, A.V., Rogers, B.E., Kenis, P.J.A., (2014), Triazine-based tool box for developing peptidic PET imaging probes: Syntheses, microfluidic radiolabeling, and structure-activity evaluation, Bioconjugate Chemistry, 25 (4), 761-772
698	Kolossov, V.L., Hanafin, W.P., Beaudoin, J.N., Bica, D.E., DiLiberto, S.J., Kenis, P.J.A. and Gaskins, H.R. (2014), Featured Article: Inhibition of glutathione synthesis distinctly alters mitochondrial and cytosolic redox poise, Experimental Biology and Medicine, 239 (4), 394-403
699	Goda, S., Selyanchyn, R., Nozoe, T., Matsui, H.and Lee, S.-W. (2014), Development of a thin-film microextraction device based on ZSM-5/Tenax TA for VOC Detection in Liquid Samples, Journal of Analytical and Bioanalytical Techniques, S12:004
700	Byrne, M.B., Kimura, Y., Kapoor, A., He, Y., Mattam, K.S., Hasan, K.M., Olson, L.N., Wang, F., Kenis, P.J.A. and Rao, C.V. (2014), Oscillatory behavior of neutrophils under opposing chemoattractant gradients supports a winner-take-all mechanism, PLoS ONE, 9 (1), e85726
701	Kaewpanha, M., Guan, G., Hao, X., Wang, Z., Kasai, Y., Kusakabe, K. and Abudula, A. (2014), Steam co-gasification of brown seaweed and land-based biomass, Fuel Processing Technology, 120, 106-112
702	Itaoka, K., Krupnick, A., Akai, M., Alberini, A., Cropper, M. and Simon, N. (2014), Age, health, and the willingness to pay for mortality risk reductions: a contingent valuation survey of Shizuoka, Japan, residents, Environmental Economics and Policy Studies, 8 (3), 211-237
703	Wei, Z. and Hu, C. (2014), An experimental study on water entry of horizontal cylinders, Journal of Marine Science and Technology (Japan), 19 (3), 338-350
704	Zhang, B., Luo, Y., Pearlstein, A.J., Aplin, J., Liu, Y., Bauchan, G.R., Payne, G.F., Wang, Q., Nou, X. and Millner, P.D. (2014), Fabrication of biomimetically patterned surfaces and their application to probing plant-bacteria interactions, ACS Applied Materials and Interfaces, 6 (15), 12467-12478
705	Demissie, Y., Valocchi, A., Cai, X., Brozovic, N., Senay, G. and Gebremichael, M. (2015), Parameter estimation for groundwater models under uncertain irrigation data, Groundwater, 53 (4), 614-625
706	Liu, H.H., Valocchi, A.J., Werth, C., Kang, Q.J. and Oostrom, M. (2014), Pore-scale simulation of liquid CO_2 displacement of water using a two-phase lattice Boltzmann model, Advances in Colloid and Interface Science, 73, 144-158
707	Kang, Q., Chen, L., Valocchi, A.J. and Viswanathan, H.S. (2014), Pore-scale study of dissolution-induced changes in permeability and porosity of porous media, Journal of Hydrology, 517, 1049-1055
708	Liu, C. and Hu. C. (2014), An efficient immersed boundary treatment for complex moving object, Journal of Computational Physics, 274, 654-680
709	Mejia-Alvarez, R., Wu, Y. and Christensen, K.T. (2014), Observations of meandering superstructures in the roughness sublayer of a turbulent boundary layer, International Journal of Heat and Fluid Flow, 48, 43-51
710	Zhang, Y., Nishizawa, O., Kiyama, T., Chiyonobu, S. and Xue, Z. (2014), Flow behaviour of supercritical CO_2 and brine in Berea sandstone during drainage and imbibition revealed by medical X-ray CT images, Geophysical Journal International, 197 (3), 1789-1807

711	Boyd, V., Yoon, H., Zhang, C.Y., Oostrom, M., Hess, N., Fouke, B., Valocchi, A.J. and Werth, C.J. (2014), Influence of Mg^{2+} on $CaCO_3$ precipitation during subsurface reactive transport in a homogeneous silicon-etched pore network, Geochimica et Cosmochimica Acta, 135, 321-335
712	Jiang, L., Yu, M., Song, Y., Liu, Y., Yang, M., Zhou, X., Zhao, Y., Dou, B., Wu, B., Xue, Z. and Li, W.Z. (2014), Study on temperature measurement in water-saturated porous media using MRI, Journal of Porous Media, 17 (4), 347-358
713	Palma-Salgado, S., Pearlstein, A.J., Luo, Y., Park, H.K., Feng, H. (2014), Whole-head washing, prior to cutting, provides sanitization advantages for fresh-cut Iceberg lettuce (Latuca sativa L.), International Journal of Food Microbiology, 179, 18-23
714	Song, Y.C., Jiang, L.L., Liu, Y., Yang, M.J., Zhou, X.H., Zhao, Y.C., Dou, B.L., Abudula, A. and Xue, Z.Q. (2014), Study of the fluid flow characteristics in a porous medium for CO_2 geological storage using MRI, Magnetic Resonance Imaging, 32 (5), 574-584
715	Garcia-Cabrejo, O. and Valocchi, A. (2014), Global Sensitivity Analysis for multivariate output using Polynomial Chaos Expansion, Reliability Engineering & System Safety, 126, 25-36
716	Wei, Z. and Hu, C. (2014), The plunging cavities formed by the impinged jet after the entry of a sphere into water, Journal of Visualization, 17 (1), 1-3
717	Miao, Y., Mo, K., Zhou, Z., Liu, X., Lan, K.-C., Zhang, G., Miller, M.K., Powers, K.A., Almer, J. and Stubbins, J.F. (2015), In situ synchrotron tensile investigations on the phase responses within an oxide dispersion-strengthened (ODS) 304 steel, Materials Science and Engineering A, 625, 146-152
718	Chen, I.-C., Kikuchi, Y., Fukushima, Y., Sugiyama, S. and Hirao, M. (2015), Developing technology introduction strategies based on visualized scenario analysis: Application in energy systems design, Environmental Progress & Sustainable Energy, 34 (3), 832-840
719	Bolind, A.M., Lillard, R.S. and Stubbins, J.F. (2015), The electrical AC impedance response of oxide scales on 9Cr–1Mo steel immersed in molten lead–bismuth eutectic alloy at 200 °C, Corrosion Science, 92, 48-57
720	Miao, Y., Beeler, B., Deo, C., Baskes, M.I., Okuniewski, M.A. and Stubbins, J.F. (2015), Defect structures induced by high-energy displacement cascades in γ uranium, Journal of Nuclear Materials, 456, 1-6
721	Watanabe, H., Shoji, Y., Yamagaki, T., Hayashi, J., Akamatsu, F. and Okazaki, K. (2014), Observation of droplet behavior of emulsified fuel in secondary atomization in flame, Journal of Thermal Science and Technology, 9 (2), JTS0009
722	Watanabe, H. and Okazaki, K. (2015), Effect of minerals on surface morphologies and competitive reactions during char gasification in mixtures of O_2 and CO_2, Proceedings of the Combustion Institute, 35 (2), 2363-2371
723	Mo, K., Zhou, Z., Miao, Y., Yun, D., Tung, H.-M., Zhang, G., Chen, W., Almer, J. and Stubbins, J.F. (2014), Synchrotron study on load partitioning between ferrite/martensite and nanoparticles of a 9Cr ODS steel, Journal of Nuclear Materials, 455 (1-3), 376-381
724	Watanabe, H., Shimomura, K. and Okazaki, K. (2015), Carbonate formation during lignin pyrolysis under CO_2 and its effect on char oxidation, Proceedings of the Combustion Institute, 35 (2), 2423-2430
725	Maghfuri, B., Sugiyama, H., Kikuchi, Y. and Hirao, M. (2014), Design methodology of biomass utilization system considering impacts on petroleum refining industry, Computer Aided Chemical Engineering, 33, 1003-1008
726	Razavieh, A., Mohseni, P.K., Jung, K., Mehrotra, S., Das, S., Suslov, S., Li, X., Klimeck, G., Janes, D.B. and Appenzeller, J. (2014), Effect of Diameter Variation on Electrical Characteristics of Schottky Barrier Indium Arsenide Nanowire Field-Effect Transistors, ACS Nano, 8 (6), 6281-6287
	B.2. Review articles
727	Adachi, C. (2014), Third-generation organic electroluminescence materials, Japanese Journal of Applied Physics, 53 (6), 060101
728	Shundo, A. and Tanaka, K. (2014), Functionalization of Polymeric Materials by Controlled Interface, Polyfile, 51 (601), 10-14
729	Yabu, H., Higuchi, T. and Jinnai, H. (2014), Frustrated phases: Polymeric self-assemblies in a 3D confinement, Soft Matter, 10 (17), 2919-2931
730	Cahill, D.G., Braun, P.V., Chen, G., Clarke, D.R., Fan, S., Goodson, K.E., Keblinski, P., King, W.P., Mahan, G.D., Majumdar, A., Maris, H.J., Phillpot, S.R., Pop, E. and Shi, L. (2014), Nanoscale thermal transport. II. 2003-2012, Applied Physics Reviews, 1 (1), 011305
731	Byrne, M.B., Leslie, M.T., Gaskins, H.R. and Kenis, P.J.A. (2014), Methods to study the tumor microenvironment under controlled oxygen conditions, Trends in Biotechnology, 32 (11), 556-563

	B.3. Proceedings
732	Aryal, K., Rajan, G., Ashrafee, T., Ranjan, V., Li, J., Rockett, A., Collins, R.W. and Marsillac, S. (2014), Effect of selenium evaporation rate on ultrathin Cu(In,Ga)Se_2 films, 2014 IEEE 40th Photovoltaic Specialist Conference, PVSC 2014, 6924921, 314-317
733	Koirala, P., Huang, Z., Junda, M., Podraza, N.J., Marsillac, S., Rockett, A.A. and Collins, R.W. (2014), Investigation of doped a-$Si_{1-x}C_x$:H as a novel back contact material for CdTe solar cells, 2014 IEEE 40th Photovoltaic Specialist Conference, PVSC 2014, 6925399, 2354-2359
734	Koirala, P., Tan, X., Li, J., Podraza, N.J., Marsillac, S., Rockett, A.A. and Collins, R.W. (2014), Mapping spectroscopic ellipsometry of CdTe solar cells for property-performance correlations, 2014 IEEE 40th Photovoltaic Specialist Conference, PVSC 2014, 6925011, 674-679
735	Erickson, T., Rockett, A., Wang, Z., Aryal, K., Marsillac, S., Koirala, P. and Collins, R.W. (2014), Nitrogen doped chalcopyrites as contacts to CdTe photovoltaics, 2014 IEEE 40th Photovoltaic Specialist Conference, PVSC 2014, 6925412, 2404-2406
736	Rajan, G., Ibdah, A.-R., Aryal, K., Ashrafee, T., Ranjan, V., Pogue, E.A., Rockett, A., Collins, R.W. and Marsillac, S. (2014), Optical enhancement of ultra-thin CIGS solar cells using multi-layered antireflection coatings, 2014 IEEE 40th Photovoltaic Specialist Conference, PVSC 2014, 6925245, 1687-1690
737	Aryal, K., Rajan, G., Ashrafee, T., Ranjan, V., Aryal, P.,Rockett, A., Collins, R.W. and Marsillac, S. (2014), Real time spectroscopic ellipsometry studies of ultrathin CIGS films deposited by 1-stage, 2-stage and 3-stage co-evaporation processes, 2014 IEEE 40th Photovoltaic Specialist Conference, PVSC 2014, 6924922, 318-322
738	Ibdah, A.-R., Aryal, P., Pradhan, P., Rajan, G., Li, J., Rockett, A.A., Marsillac, S. and Collins, R.W. (2014), Solar cells with thin Cu($In_{1-x}Ga_x$)Se_2 absorbers: Optical analysis and quantum efficiency simulations, 2014 IEEE 40th Photovoltaic Specialist Conference, PVSC 2014, 6924935, 373-378
739	Heinzel, D.P., Wu, H.M. and Rockett, A. (2014), Stochastic analysis of advanced photovoltaic devices, 2014 IEEE 40th Photovoltaic Specialist Conference, PVSC 2014, 6925476, 2656-2661
740	Yang, Z., Koirala, P., Collins, R.W., Aryal, K., Marsillac, S. and Rockett, A. (2014), Transition metal nitride contacts for CdTe photovoltaics, 2014 IEEE 40th Photovoltaic Specialist Conference, PVSC 2014, 6925256, 1735-1739
741	Chabak, K. D, Miao, X., Zhang, C., Walker, D.E. and Li, X.L. (2014), RF Performance of 3D III-V Nanowire T-Gate HEMTs Grown by VLS Method, 2014 72 72nd Annual Device Research Conference (DRC), 211-212
742	Kernion, S.J., Magee, J.H., Werley, T.N., Maxwell, P.B. and Somerday, B.P. (2014), Measurement of hydrogen embrittlement resistance of alloys 718 and custom age 625 Plus® using the rising step load technique, 8th International Symposium on Superalloy 718 and Derivatives 2014, 629-641
743	Cui, B., Kacher, J., Bertsch, K., Wang, S., McMurtrey, M., Was, G., Nagao, A., Martin, M., Sofronis, P. and Robertson, I.M. (2014), Dislocation interactions with grain boundaries, Risoe International Symposium on Materials Science
744	Marchi, C.S. and Somerday, B.P. (2014), Comparison of stainless steels for high-pressure hydrogen service, American Society of Mechanical Engineers, Pressure Vessels and Piping Division (Publication) PVP, PVP2014-28811, V06BT06A023
745	Yamabe, J., Itoga, H., Awane, T., Matsunaga, H., Hamada, S. and Matsuoka, S. (2014), Fatigue-Life and Leak-Before-Break Assessments of Cr-Mo Steel Pressure Vessels With High-Pressure Gaseous Hydrogen, The American Society of Mechanical Engineers, PVP2014-28604, V06BT06A019
746	Iijima, T., Itoga, H., An, B., Marchi, C.S. and Somerday, B.P. (2014), Measurement of fracture properties for ferritic steel in high-pressure hydrogen gas, American Society of Mechanical Engineers, Pressure Vessels and Piping Division (Publication) PVP, 6B, PVP2014-28815, V06BT06A024
747	An, B., Iijima, T., Marchi, C.S. and Somerday, B. (2014), Micromechanisms of hydrogen-assisted cracking in super duplex stainless steel investigated by scanning probe microscopy, American Society of Mechanical Engineers, Pressure Vessels and Piping Division (Publication) PVP, 6B, PVP2014-28181, V06BT06A009
748	Itoga, H., Matsuo, T., Orita, A., Matsunaga, H., Matsuoka, S. and Hirotani, R. (2014), SSRT and fatigue crack growth properties of high-strength austenitic stainless steels in high-pressure hydrogen gas, American Society of Mechanical Engineers, Pressure Vessels and Piping Division (Publication) PVP, 6B, V06BT06A020
749	Matsunaga, H., Yoshikawa, M., Itoga, H., Yamabe, J., Hamada, S. and Matsuoka, S. (2014), Tensile-and fatigue-properties of low alloy steel JIS-SCM435 and carbon steel JIS-SM490B in 115 MPA hydrogen gas, American Society of Mechanical Engineers, Pressure Vessels and Piping Division (Publication) PVP, 6B, V06BT06A015

750	Lwin Moe, A., Fukuda, K., Abu, A. and Razdi, R. (2014), An investigation of lapping characteristics for mirror-like finish using a lathe with linear motor, Applied Mechanics and Materials, 564, 469-474
751	Sirthanakorn, T., Tanaka, M. and Higashida, K. (2014), Two-step brittle-to-ductile transitions in pearlitic steels, Advanced Materials Research, 922, 706-710
752	Itoga, H., Matsunaga, H. and Matsuoka, S. (2014), Effect of hydrogen gas on the growth of small fatigue crack in JIS-SCM435, Advanced Materials Research, 891-892, 942-947
753	Chen, Y.Z., Herz, A., Borchers, C., Shi, X.H., Ma, X.Y., Liu, F. and Kirchheim, R. (2014), Inhibition of grain coarsening in nanocrystalline Fe-C alloys by interaction between carbon and grain boundaries, Advanced Materials Research, 904, 184-188
754	Yarimitsu, S., Nakashima, K., Sawae, Y. and Murakami, T. (2014), Effect of synovial fluid constituents on tribological performance of artificial hydrogel cartilage material, 5th World Tribology Congress, WTC 2013, 3, 2279-2282
755	Mizuta, H. and Sugimura, J. (2014), Frictional behavior of radial lip seals in mixed lubrication, 5th World Tribology Congress, WTC 2013, 3, 1893-1894
756	Kirchheim, R., Borchers C, Li, Y.J. and Raabe, D. (2014), On the way to nanocrystalline steel by wire drawing of pearlitic steel and ball milling of iron, Proceedings of the 35th Risoe International Symposium on Materials Science, 59-72
757	Lyth, S., Liu, J.,Daio, T. and Sasaki, K. (2014), Defective Nitrogen-Doped Graphene Foam: A Highly Durable Electrocatalyst for Alkaline Medium, ECS and SMEQ Joint International Meeting, MA2014-02, 1302
758	Ito, K., Maeda, Y., Sakaguchi, T., Inada, A. and Nakajima, H. (2014), Impact of Water Flow Rate on Current Efficiency in Solid Polymer Water Electrolyzer Under 2 MPa Condition, ECS Transactions, 64 (3), 1019-1028
759	Zakutayev, A., Perry, N., Mason, T., Ginley, D. and Lany, S. (2014), Metastable defects are the origin of high conductivity in gallium doped zinc oxide, Bulletin of the American Physical Society, 59, 1
760	Zhao, X.J., Hayashi, A., Noda, Z. and Sasaki, K. (2014), Evaluation of MEAs Prepared by Pt/C Electrocatalysts with Improved Durability through the Heat Treatment, ECS Transactions, 58 (24), 7-13
761	Rouf, R.A., Alam, K.C.A., Khan, M.A.H., Saha, B.B., Meunier, F., Alim, M.A. and Kabir, K.M.A. (2014), Advancement of Solar Adsorption Cooling by Means of Heat Storage, Procedia Engineering, 90, 649-656
762	Sivasankaran, H., Takata, Y. and Kohno, M. (2014), Enhanced thermal transport of nanostructured phase change composite for thermal energy storage, ASME International Mechanical Engineering Congress and Exposition, Proceedings (IMECE), 6B
763	Moroizumi, H., Chiashi, S., Takata, Y. and Kohno, M. (2014), Water Molecule Adsorption on Vertically Aligned Single-Walled Carbon Nanotubes, ASME 2014 12th International Conference on Nanochannels, Microchannels, and Minichannels collocated with the ASME 2014 4th Joint US-European Fluids Engineering Division Summer Meeting, ICNMM2014-21468, V001T08A003
764	Tsuru, K., Yamada, Y., Ikuta, T., Nishiyama, T. and Takahashi, K. (2014), Experimental Study on Thermal Contact Resistance of Multi-Walled Carbon Nanotubes, ASME 4th International Conference on Micro/Nanoscale Heat and Mass Transfer-2013, V001T03A003
765	Nishiyama, T., Takahashi, K. and Takata, Y. (2014), Nanobubbles on a Very Flat Hydrophobic Surface Prepared by Self-Assembled Monolayers, ASME 4th International Conference on Micro/Nanoscale Heat and Mass Transfer-2013, V001T04A003
766	Terada, D., Kaneda, Y., Horita, Z., Matsuda, K., Hirosawa, S. and Tsuji, N. (2014), Mechanical properties and microstructure of 6061 aluminum alloy severely deformed by ARB process and subsequently aged at low temperatures, IOP Conference Series: Materials Science and Engineering, 63 (1), 012088
767	Isik, M., Niinomi, M., Cho, K., Nakai, M., Hieda, J., Yilmazer, H., Horita, Z. and Narushima, T. (2014), Microstructural analysis of biomedical Co-Cr-Mo alloy subjected to high-pressure torsion processing, Key Engineering Materials, 616, 263-269
768	Maruno, S., Watanabe, K., Matsuda, K., Saikawa, S., Hirosawa, S., Horita, Z., Lee, S. and Terada, D. (2014), TEM observation of HPT-processed cu-added excess Mg-type Al-Mg-Si alloys, Materials Science Forum, 794-796, 811-814
769	Maruno, S., Saikawa, S., Hirosawa, S., Hamaoka, T., Horita, Z., Lee, S., Terada, D. and Matsuda, K. (2014), Effect of HPT on age-hardening behavior in Cu-added excess Mg-type Al-Mg-Si alloys, Advanced Materials Research, 922, 487-490
770	Ezaki, M., Michida, W. and Kusakabe, K. (2014), Photocatalytic degradation with WO_3/TiO_2 composites under UV and visible light, Applied Mechanics and Materials, 625, 293-297

771	Jamil, M.F., Uemura, Y., Osman, N., Kusakabe, K. and Yusup, S. (2014), Review on extraction and characterization of castor seed oil, Applied Mechanics and Materials, 625, 916-919
772	Ab Rashid, W.N.W., Uemura, Y., Kusakabe, K., Osman, N.B. and Abdullah, B. (2014), Synthesis of Biodiesel from Palm Oil in Capillary Millichannel Reactor: Effect of Temperature, Methanol to Oil Molar Ratio, and KOH Concentration on FAME Yield, International Conference and Workshop on Chemical Engineering UNPAR 2013 (ICCE UNPAR 2013), 9, 165-171
773	Kawata, Y., Xue, Z., Mito, S. and Nakajima, T. (2014), A history matching study of nagaoka site for geochemical model calibration in reactive transport model: Using concentration changes of chemical species from post-injection water sampling data, Energy Procedia, 63, 3568-3575
774	Mehnert, E., Damico, J., Frailey, S., Leetaru, H., Okwen, R., Storsved, B. and Valocchi, A. (2014), Basin-scale modeling for CO_2 sequestration in the basal sandstone reservoir of the Illinois Basin-improving the geologic model, Energy Procedia, 63, 2949-2960
775	Nakajima, T., Nishizawa, O. and Xue, Z. (2014), Characterization on reservoir complex and CO_2 plume with Vp/Vs: Case study at Nagaoka site, Japan, Energy Procedia, 63, 2961-2968
776	Nakano, K., Ohbuchi, A., Mito, S. and Xue, Z. (2014), Chemical interaction of well composite samples with supercritical CO_2 along the cement - Sandstone interface, Energy Procedia, 63, 5754-5761
777	Xue, Z., Park, H., Kiyama, T., Hashimoto, T., Nishizawa, O. and Kogure, T. (2014), Effects of hydrostatic pressure on strain measurement with distributed optical fiber sensing system, Energy Procedia, 63, 4003-4009
778	Zhang, Y., Nishizawa, O., Kiyama, T. and Xue, Z. (2014), Hysteretic elastic wave velocity and attenuation in partially saturated sandstone by CO_2 and brine: Evidenced by an experimental study with X-ray CT, Energy Procedia, 63, 4437-4448
779	Xue, Z., Nishio, S., Hagiwarab, N. and Matsuoka, T. (2014), Microbubble carbon dioxide injection for enhanced dissolution in geological sequestration and improved oil recovery, Energy Procedia, 63, 7939-7946
780	Nakajima, T., Xue, Z., Chiyonobu, S. and Azuma, H. (2014), Numerical simulation of CO_2 leakage along fault system for the assessment of environmental impacts at CCS site, Energy Procedia, 63, 3234-3241
781	Ito, T., Nakajima, T., Chiyonobu, S. and Xue, Z. (2014), Petrophysical properties and their relation to injected CO_2 behavior in a reservoir at the Nagaoka pilot site, Japan, Energy Procedia, 63, 2855-2860
782	Azuma, H., Xue, Z. and Matsuoka, T. (2014), Utilization of seismic attenuation in the monitoring of CO_2 geological storage project, Energy Procedia, 63, 4216-4223
783	Streibel, M., Finley, R.J., Martens, S., Greenberg, S., Möller, F. and Liebscher, A. (2014), From pilot to demo scale - Comparing Ketzin results with the Illinois basin-decatur project, Energy Procedia, 63, 6323-6334
784	Hu, C., Sueyoshi, M., Liu, C. and Liu, Y. (2014), Hydrodynamic analysis of a semi-submersible type floating wind turbine, Proceedings of the 11th (2014) Pacific/Asia Offshore Mechanics Symposium, PACOMS 2014, 1-6
785	Liu, C. and Hu. C. (2014), CFD Simulation of a Floating Wind Turbine Platform in Rough Sea Conditions, Proceedings of the International Offshore and Polar Engineering Conference, 325-329
786	Liu, Y., Hu, C., Sueyoshi, M., Yoshida, S., Honda, Y. and Ohya, Y. (2014), Time domain simulation of a semi-submersible type floating wind turbine, Proceedings of the International Offshore and Polar Engineering Conference, 288-293
787	Tsuji, T. and Jiang, F. (2014), Evolution of hydrological and elastic properties due to mineral precipitation in CCS project: Application of two-phase Lattice-Boltzmann method to large-size digital rock and integration of mineralogical modeling, MMIJ Spring Meeting, 37-5
788	Tsuji, T., Matsuoka, T., Kitamura, K., Yamada, Y., Onishi, K., Kadir, W.G.A. and Ariadji, T. (2014), Pilot Study on CCS in Gundih Gas Field in Central Java, Indonesia: Reservoir Characterization and simulation for site selection, MMIJ Spring Meeting, 37-8
789	Kitamura, K., Yamada, Y., Onishi, K., Tsuji, T., Benyamin, S., Bahar, A., Matsuoka, T. and Kadir, W.G.A. (2014), Pilot Study on CCS in Gundih Gas Filed in Central Java, Indonesia-Reservoir evaluation from Petrophysical parameter-, MMIJ Spring Meeting, 37-7
790	Mehta, V., Cohen, J. and Pearlstein, A.J. (2014), Experimental investigation of the transition in pipe flow, 54th Israel Annual Conference on Aerospace Sciences 2014, 3, 1399-1410
791	Nakamura, M., Kawatani, T., Asakawa, K., Hyakutome, T. and Yoshida, A. (2014), Constant Acceleration Test and Motion Simulation of Underwater Glider “Tsukuyomi”, Proceedings of the International Offshore and Polar Engineering Conference, 2, 456-462

792	Watanabe, H., Shimomura, K. and Okazaki, K. (2014), Experimental investigation of carbonate formation characteristics during coal and biomass pyrolysis under CO_2, Energy and Fuels, 28 (7), 4795-4800
793	Mo, K., Miao, Y., Zhou, Z., Yun, D., Liu, X., Aimer, J. and Stubbins, J.F. (2014), Nanoparticles loading behavior before and after matrix necking: An in-situ synchrotron radiation study in a 9Cr ODS alloy, Transactions of the American Nuclear Society, 110, 1009-1011
794	Miao, Y., Mo, K., Liu, X., Zhou, Z., Aimer, J. and Stubbins, J.F. (2014), Response of oxide particles to externally applied stress in austenitic ods alloys, Transactions of the American Nuclear Society, 110, 853-854
795	Chen, W.-Y., Miao, Y., Tomchik, C.A., Mo, K., Gan, J., Okuniewski, M.A., Wu, Y.Q., Maloy, S.A. and Stubbins, J.F. (2014), TEM, APT and hardness studies of neutron-irradiated ferritic Fe-Cr single crystals, Transactions of the American Nuclear Society, 110, 1006-1008
	B.4. Other English articles (Editorial materials)
796	Ishihara, T. and Ida, S. (2014), ICH2P-2014 Preface, International Journal of Hydrogen Energy, 39 (35), 20591
797	Chair, J.M., Yamaguchi, S., Eguchi, K., Ishihara, T. and Tatsumisago, M. (2014), The 19th International Conference on Solid State Ionics (SSI-19) Preface, Solid State Ionics, 262, 1-1
798	Mathaudhu, S.N., Estrin, Y., Horita, Z., Lavernia, E., Liao, X.Z., Lu, L., Wei, Q., Wilde, G. and Zhu, Y.T. (2014), Preface to the special issue on ultrafine-grained materials, Journal of Materials Science, 49 (19), 6485-6486
799	Smith, Z.P and Freeman, B.D. (2014), Graphene Oxide: A New Platform for High-Performance Gas- and Liquid-Separation Membranes, Angewandte Chemie - International Edition, 53 (39), 10286-10288
800	Zhou, Z., Muroga, T., Henager, C.H., Kurtz, R., Woo, C.-H., Spatig, P. and Stubbins, J. (2014), 16th International Conference on Fusion Reactor Materials, Journal of Nuclear Materials, 455 (1-3)
801	Koyama, M., Kato, Y. and Nakagawa, N. (2014), Preface to the Special Issue for International Symposium on Innovative Materials for Processes in Energy Systems 2013, Journal of Chemical Engieering of Japan, 47 (7), 497-497
	B.4. Other English articles (Meeting abstracts)
802	Takahara, A. and Kobayashi, M. (2014), Chain dimensions and surface characterization of superhydrophilic polymer brushes with zwitterion side groups prepared by ATRP, Abstracts of Papers of the American Chemical Society, 248, 713-POLY
803	Zhou, M., Goldman, A.S., Crabtree, R.H., Goddard, W.A., Eisenstein, O., Brudvig, G.W., Periana, R.A., Balcells, D., Parent, A.R., Hintermair, U., Schley, N.D., Elimelech, M., Hashiguchi, B.G., Hashmi, S.M., Johnson, S. and Nielsen, R. (2014), Iridium(III) complexes in selective C-H oxidation, Abstracts of Papers of the American Chemical Society, 248, 43-AEI
804	Hirai, T., Kido, M., Shinohara, T., Nojima, S., Kim, J., Ota, N., Ishige, R., White, K., Higaki, Y. and Takahara, A. (2014), Synthesis of polymer with perylene diimide pendant side chains and characterization of its higher order structure, Abstracts of Papers of the American Chemical Society, 248, 405-POLY
805	Otsuka, H., Kanehara, T., Irie, A., Imato, K., Ohishi, T. and Takahara, A (2014), Dynamic covalent polymers with autonomous exchangeability and reorganizability at ambient temperature, Abstracts of Papers of the American Chemical Society, 247, 362-PMSE
806	Gewirth, A.A., Tavassol, H. and Hoang, T.T.H. (2014), Electrolyte and adsorbate contributions to surface stress evolution in batteries and fuel cells, Abstracts of Papers of the American Chemical Society, 247, 81-ENFL
807	Hirai, T., Zheng, X.Y., Sato, M., Higaki, Y. and Takahara, A. (2014), Preparation of poly(alpha-methylen-gamma-butyrolactone) and evaluation of its surface physical properties, Abstracts of Papers of the American Chemical Society, 247, 65-COLL
808	Sato, T., Ohishi, T., Takahara, A. and Otsuka, H. (2014), Reversible surface modification of reactive polymer brushes based on dynamic covalent chemistry, Abstracts of Papers of the American Chemical Society, 247, 314-POLY
809	Chu, W.Y., Zhou, X.Y. and Rauchfuss, T.B. (2014), Tetradentate dianionic diphosphino ligands: New ligand platforms for iron(II) complexes, Abstracts of Papers of the American Chemical Society, 248, 977-INOR
810	Ulloa, O., Rauchfuss, T.B. and Ulloa, O. (2014), Mixed-Valence [NiFe-mu-hydrido]n (n=0, 2) Complexes Relevant to the Active-Site of [NiFe]-Hydrogenases, Journal of Biological Inorganic Chemistry, 19, S534

811	Chambers, G., Angamuthu, R., Mitra, J., Rauchfuss, T.B. and Stein, M. (2014), Ni-Ru Dithiolates as Models for the Ni-L State in [NiFe]-Hydrogenase, Journal of Biological Inorganic Chemistry, 19, S519
812	Chu, W. and Rauchfuss, T.B. (2014), Stabilization of M-CO_2 Complexes by Cationic Lewis Acids, Journal of Biological Inorganic Chemistry, 19, S506
813	Smith, Z.P., Czenkusch, K., Wi, S., Gleason, K.L., Gutierrez, G.H., Lozano, A.E., Paul, D.R. and Freeman, B.D. (2014), Effect of chemical structure and synthesis route on transport properties of thermally rearranged polymers, Abstracts of Papers of the American Chemical Society, 248, 612-POLY
814	Gleason, K.L., Smith, Z.P., Liu, Q., Paul, D.R. and Freeman, B.D. (2014), Influence of water vapor on mixed-gas permeation of CO_2/N_2 in thermally rearranged (TR) polymers, Abstracts of Papers of the American Chemical Society, 248, 610-POLY
815	Kamcev, J., Freeman, B.D. and Paul, D.R. (2014), Ion sorption and transport in ion-exchange membranes, Abstracts of Papers of the American Chemical Society, 248, 621-PMSE
816	Borjigin, H., Liu, Q., Gaines, K., Zhang, W.R., Mecham, S., McGrath, J.E. and Freeman, B.D. (2014), Synthesis, characterization, and gas transport properties of isomeric thermal rearranged (TR) polymer for gas separation membranes, Abstracts of Papers of the American Chemical Society, 248, 613-POLY
817	Nebipasagil, A., Sundell, B.J., Lane, O.R., Mecham, S.J., Jang, E.S., Freeman, B.D. and McGrath, J.E. (2014), UV-crosslinked telechelic disulfonated poly (arylene ether sulfone) oligomers for reverse osmosis membrane applications, Abstracts of Papers of the American Chemical Society, 248, 299-ENVR
818	Kenis, P.J.A. (2014), Catalysts for efficient electrochemical reduction of CO_2 to CO, Abstracts of Papers of the American Chemical Society, 247, 154-ENFL
819	Kim, B., Ma, S.C., Jhong, H.R.M. and Kenis, P.J.A. (2014), Effect of diluted CO_2 streams on the electrochemical reduction of CO_2, Abstracts of Papers of the American Chemical Society, 247, 61-ENFL
820	Ma, S.C., Thorson, M.R. and Kenis, P.J.A. (2014), Supported catalysts for the efficient electrochemical conversion of CO_2 to CO, Abstracts of Papers of the American Chemical Society, 247, 194-CATL
	B.4. Other English articles (Book chapters)
821	Funahashi, M., Yasuda, T. and Kato, T. (2014), Liquid Crystal Semiconductors: Oligothiophene and Related Materials, Handbook of Liquid Crystals, 2nd edition, Chap. 21, 8, 675-708
822	Isoda, K., Yasuda, T., Funahashi, T. and Kato, T. (2014), Redox-Active (Electrochromic) Liquid Crystals, Handbook of Liquid Crystals, 2nd edition, Chap. 22, 8, 709-725
823	Rupp, J.L.M. (2014), Solid Oxide Fuel Cells: Introduction, Encyclopedia of Applied Electrochemistry, 2018-2023
	B.4. Other English articles (Textbook chapter)
824	Kirchheim, R. and Pundt, A. (2014), Hydrogen in Metals, Physical Metallurgy, 3, 2597-2705
	B.4. Other English articles (Note)
825	Gogotsi, Y., McCreery, R., Lyth, S.M., et al. (2014), Carbon electrode interfaces for synthesis, sensing and electrocatalysis: General discussion, Faraday Discussions, 172, 497-520
	B.5. Articles written in other than English (Original articles in Japanese)
826	Yoshinaga, K., Yonezawa, A., Motokucho, S. and Kojio, K (2014), Synthesis of ZnO Nanoparticles Using Reverse Micelles of Block Copolymer Hybridized with ZnO/PMMA, Kobunshi Ronbunshu, 71 (12), 644-650
827	Kojio, K., Matsumura, H., Nozaki, S., Motokucho, S., Furukawa, M., Yoshinaga, K. and Takahara, A. (2014), Crystallization Behavior of Hard Segment in Polyurethane Elastomers, Kobunshi Ronbunshu, 71 (11), 608-614
828	Kojio, K., Matsumura, S., Komatsu, T., Nozaki, S., Motokucho, S., Furukawa, M. and Yoshnaga, K. (2014), Microphase-Separated Structure and Dynamic Viscoelastic Properties of Polyurethanes Elastomers Prepared at Various Temperatures and Cross-Linking Agent Contents, Nihon Reoroji Gakkaishi, 42 (2), 143-149
829	Tanaka, M., Maeno, K., Yoshimura, N., Hoshino, M., Uemori, R., Ushioda, K. and Higashida, K. (2014), Effect of Mn addition on a brittle-to-ductile transition in ferritic steels, Tetsu-To-Hagane/Journal of the Iron and Steel Institute of Japan, 100 (10), 1267-1273

830	Yoshiwa, M., Matsuo, T., tsutsumi, N., Matsunaga, H. and Matsuoka, S. (2014), Effects of hydrogen gas pressure and test frequency on fatigue crack growth properties of low carbon steel in 0.1–90 MPa hydrogen gas, Transactions of the JSME, 80 (817), SMM0254
831	Fukuda, K. (2014), Tribology in Malaysia, Toraibarojisuto/Journal of Japanese Society of Tribologists, 59 (9), 529-534
832	Fujisawa, M., Mauchi, R., Morikawa, T., Tanaka, M. and Higashida, K. (2014), Influence of strain-induced martensite on tensile properties of metastable duplex stainless steels consisting of Fe-Cr-Mn-Ni and Fe-Cr-Mn-N, Tetsu-To-Hagane/Journal of the Iron and Steel Institute of Japan, 100 (9), 1140-1149
833	Ogawa, K., Yokouchi, Y., Haishi, T. and Ito, K. (2014), Development of a measurement technique for current-density in PEFC using planar surface coil as a NMR signal detector (Third report: Inversion analysis of current-density distribution generating in PEFC at case of current flowing in lamination direction), Nihon Kikai Gakkai Ronbunshu, B Hen/Transactions of the Japan Society of Mechanical Engineers, Part B, 80 (812), TEP0093
834	Fukuda, H., Nakata, N., Kijima, H., Kuroki, T., Fujibayashi, A., Takata, Y. and Hidaka, S. (2014), Effects on surface conditions on spray cooling characteristics, Tetsu-To-Hagane/Journal of the Iron and Steel Institute of Japan, 100 (12), 1514-1522
835	Kikuchi, Y. (2014), Activity and data models for process assessment considering sustainability, Kagaku Kogaku Ronbunshu, 40 (3), 211-223
836	Uehara, E., Kikuchi, Y. and Hirao, M (2014), Multi-viewpoint activity model of environmental and health risk management for middle-stream industrial processes in the supply chain, Kagaku Kogaku Ronbunshu, 40 (3), 174-186
	B.5. Articles written in other than English (Original articles in Chinese)
837	Liu, J.-H., Wang, H.-D., Hu, Y.-D., Ma, W.-G., Zhang, X. (2014), Experimental study of temperature dependent thermal contact resistance of individual carbon fibers, Kung Cheng Je Wu Li Hsueh Pao/Journal of Engineering Thermophysics, 35 (9), 1789-1792
838	Hu, Y., Liu, J., Wang, H. and Zhang, X. (2014), Simultaneous measurement of thermal properties and convective heat transfer coefficient of individual carbon fiber using Raman spectroscopy, Huagong Xuebao/CIESC Journal, 65, SUPPL. 1, 251-257
839	Wu, B.-H., Song, M.-X., Chen, K. and Zhang, X. (2014), The development of real-time speed and temperature prediction system for single wind turbine, Kung Cheng Je Wu Li Hsueh Pao/Journal of Engineering Thermophysics, 35 (2), 295-298
840	Li, Q.-Y. and Zhang, X. (2014), Raman spectra method for measuring viscosity of supercritical fluids, Kung Cheng Je Wu Li Hsueh Pao/Journal of Engineering Thermophysics, 35 (4), 757-761
	B.5. Articles written in other than English (Review article in Japanese)
841	Matsuno, H. and Tanaka, K. (2014), An Effect of Mechanical Properties of Polymer Surface on Fibroblast Adhesion, Nippon Gomu Gyokaishi (Journal of the Society of Rubber Science and Technology), 87 (10), 434-439
	B.5. Articles written in other than English (Editorial material in Japanese)
842	Tsuchiyama, T. (2014), Preface to the 100th volume memorial special issue on physical metallurgy 1-microstructure control and material properties, Tetsu-To-Hagane/Journal of the Iron and Steel Institute of Japan, 100 (9), 1049
	B.5. Articles written in other than English (Book chapter in Japanese)
843	Nishihara, M., et al. Energy conversion technologies, Kagaku-binran (Handbook of Chemistry), Applied Chemistry, 7th Edition, Chap. 24
	B.5. Articles written in other than English (Note in Japanese)
844	Takahara, A. (2014), Fundamental science of polymer thin films, Kobunshi, 63 (2), 95
	B.5. Articles written in other than English (Magazine article in Japanese)
845	Yamabe, J., Matsunaga, H., Hamada, S. and Matsuoka, S. (2014), Proposal of Design Method for Materials Used in High-pressure Hydrogen Gas Environment, The Journal of Fuel Cell Technology, 14 (2), 9-16

B. Invited Lectures, Plenary Addresses (etc.) at International Conferences and International Research Meetings
- List up to 10 main presentations during FY2014 in order from most recent.
- For each, write the lecturer/presenter's name, presentation title, conference name and date(s)

No.	Lecturer/presenter names and details
1	Ishihara, T., New Technology for Carbon Neutral Energy, 8th International Conference on Materials Science and Technology MSAT-8, Bangkok, Thailand, Dec. 15, 2014 (Plenary)
2	Matsunaga, H., Dominant Factors for Very High Cycle Fatigue of High Strength Steels, The Sixth International Conference on Very High Cycle Fatigue (VHCF-6), Chengdu, China, Oct. 17, 2014 (Keynote)
3	Nakashima, N., Design and Creation of Advanced Nanomaterials Based on Soluble Carbon Nanotubes, 2014 MRS Spring Meeting & Exhibit, San Francisco, CA, USA, Apr. 23, 2014 (Invited)
4	Takata, Y., Effect of Dissolved Air and Subcooling on Bubble Nucleation from a Hydrophobic Spot, Gordon Research Conference "Micro & Nanoscale Phase Change Heat Transfer", Galveston, TX, USA, Jan. 12, 2015 (Invited)
5	Akiba, E., Hydrogen Storage in Japan -Recent Progress and Future prospect-, Hy-SEA 2014 Hydrogen Storage - Embrittlement – Applications, Rio de Janeiro, Brazil, Oct. 26-30, 2014 (Plenary)
6	Yamauchi, M., Fe-Group Nanoalloy Catalysts : Toward Realization of a Sustainable Society, 97th Canadian Chemistry Conference and Exhibition, Vancouver, Vancouver, Canada, Jun. 5, 2014 (Invited)
7	Fujikawa, S., Fabrication and application of nanometer-thick membrane, Special symposium on the celebration for the Order of Culture of Prof. Toyoki Kunitake, Tokyo, Japan, Nov. 21, 2014 (Invited)
8	Tsuji, T., Digital rock physics: Insight into fluid flow and elastic deformation of porous media, GeoMod2014, Potsdam, Germany, Sep. 3, 2014 (Keynote)
9	Itaoka, K., Public understanding on CCS in Japan, International CCS Symposium for Low-Carbon Society, Tokyo, Japan, Feb. 12, 2015 (Invited)
10	Christensen, K.T., Quantitative Studies of Environmental Flows at the Micro- and Macro-Scales, 16^{th} International Symposium on Flow Visualization, Okinawa, Japan, June 27, 2014 (Keynote)

C. Major Awards

- List up to 10 main awards received during FY2014 in order from the most recent.
- For each, write the recipient's name, name of award, and year issued.
- In case of multiple recipients, underline those affiliated with the center.

No.	Recipient names and details
1	Ian Robertson 2014 Edward DeMille Campbell Memorial Lecture ASM International, 2015
2	Takeshi Tsuji Young Researcher Award, The Seismological Society of Japan, 2015
3	Toyoki Kunitake Order of Culture 2014, Government of Japan, 2014
4	Akihide Nagao Invention and Innovation Award 2014-Encouragement Prize, Japan Institute of Invention and Innovation, 2014
5	Atsushi Takahara Outstanding Contribution and Innovation in Fluoropolymer Science at FLUOROPOLYMER 2014, French Fluorine Network
6	Hellena Téllez-Lozano Best Scientific Contribution Award for Decrease of the electrochemically active surface in mixed ionic-electronic conductors (MIECs) by impurity segregation, 11th European SOFC&COE FORUM 2014
7	<u>Hellena Téllez-Lozano</u>, <u>John Druce</u>, Ju, Y.-W., <u>Tatsumi Ishihara</u>, and <u>John Kilner</u> Christian Friedrich Schonbein Contribution to Science Medal, European Fuel Cell Forum 2014 (EFCF 2014)
8	Brian Somerday DOE Hydrogen and Fuel Cells Program Achievement Award for Hydrogen Delivery and Safety, Codes and Standards, 2014
9	Harry Tuller Fellow, Electrochemical Society, 2014

FY 2014 List of Principal Investigators

NOTE:
・Underline names of principal investigators who belong to an overseas research institution.
・In case of researchers not listed in the latest report, attach "Biographical Sketch of a New Principal Investigator".

<Results at the end of FY2014>

Principal Investigators　Total:24

Name (Age)	Affiliation (Position title, department, organization)	Academic degree, specialty	Working hours (Total working hours: 100%) Work on center project: Research activities	Work on center project: Other activities	Others: Research activities	Others: Other activities	Starting date of project participation	Status of project participation (Describe in concrete terms)	Contributions by PIs from overseas research institutions
Center director Petros Sofronis (57)	Prof., International Institute for Carbon-Neutral Energy Research, Kyushu University	Ph.D., Micromechanics of materials, Environmental degradation of materials	15%	75%	5%	5%	2010, Dec.1st	・Manages the Institute from Illinois Satellite ・Travels to the Institute to participate in events and exchange with researchers (48% time) ・Promotes I^2CNER's interests to various research institutions and industries on a daily basis ・Daily exchange of e-mails ・Participates in meetings/events via videoconference system	・Manages and directs I^2CNER's operations
Tatsumi Ishihara (53)	Prof., International Institute for Carbon-Neutral Energy Research, Kyushu University	Dr. of Eng., Catalyst and solid state electrochemistry	90%	10%	0%	0%	2010, Dec.1st	・Located at I^2CNER ・Participates in research/events as Associate Director, Head of Hydrogen Production Division	
Chihaya Adachi (51)	Prof., Department of Applied Chemistry, Kyushu University	Dr. of Eng., Materials science and device physics	60%	20%	10%	10%	2010, Dec.1st	・Located at I^2CNER ・Participates in research/events	

Atsushi Takahara (59)	Prof., Institute for Materials Chemistry and Engineering, Kyushu University	Dr. of Eng., Surface and Interface Characterization	60%	20%	10%	10%	2010, Dec.1st	• Located at I^2CNER • Participates in research/events	
Seiji Ogo (51)	Prof., International Institute for Carbon-Neutral Energy Research, Kyushu University	Dr. of Science, Green Chemistry	90%	10%	0%	0%	2010, Dec.1st	• Located at I^2CNER • Participates in research/events as Head of Catalytic Materials Transformations Division	
Zenji Horita (61)	Prof., International Institute for Carbon-Neutral Energy Research, Kyushu University	Ph.D., Dr. of Eng., Materials Science	90%	10%	0%	0%	2010, Dec.1st	• Located at I^2CNER • Participates in research/event	
Naotoshi Nakashima (63)	Prof., International Institute for Carbon-Neutral Energy Research, Kyushu University	Ph. D., Nanocarbon science, Supramolecular science	85%	15%	0%	0%	2010, Dec.1st	• Located at I^2CNER • Participates in research/events	
Kazunari Sasaki (50)	Prof., International Institute for Carbon-Neutral Energy Research, Kyushu University	Dr. of Science and technology, Fuel cell materials, Inorganic materials	90%	10%	0%	0%	2010, Dec.1st	• Located at I^2CNER • Participates in research/events as Head of Fuel Cell Division	
Etsuo Akiba (63)	Prof., International Institute for Carbon-Neutral Energy Research, Kyushu University	Dr. of Science, Materials science	70%	30%	0%	0%	2010, Dec.1st	• Located at I^2CNER • Participates in research/events as Head of Hydrogen Storage Division	
<u>Harry L. Tuller</u> (69)	Prof. Department of Materials Science and Engineering, Massachusetts Institute of Technology	Eng. Sc. D., Functional electroceramic materials	35%	5%	45%	15%	2010, Dec.1st	• Primarily located at partner institution • Participates in research • Visited I^2CNER for four weeks to participate in events and exchange opinions for collaborative research projects • Discussion via Internet	

John A Kilner (68)	Prof., Department of Materials, Imperial College, London	PhD., Materials for solid oxide fuel cells and electrolysers	35%	5%	45%	15%	2010, Dec.1st	・Primarily located at partner institution Participates in research ・Visited I^2CNER for six weeks for research to participate in events and exchange opinions for collaboration ・Regular discussion via Internet	
Joichi Sugimura (57)	Prof., International Institute for Carbon-Neutral Energy Research, Kyushu University	Dr. of Eng., Tribology and Machine Design	70%	30%	0%	0%	2010, Dec.1st	・Located at I^2CNER ・Participates in research/events	
Yasuyuki Takata (58)	Prof., International Institute for Carbon-Neutral Energy Research, Kyushu University	Dr. of Eng., Thermal Engineering	70%	30%	0%	0%	2010, Dec.1st	・Located at I^2CNER ・Participates in research/events as Associate Director, Head of Thermal Sciences and Engineering Division	
Xing Zhang (53)	Prof., Department of Engineering Mechanics, Tsinghua University	Ph.D., Thermal Science	10%	10%	45%	35%	2010, Dec.1st	・Primarily located at partner institution ・Participates in research/events ・Visited I^2CNER for seven weeks to conduct research, participate in events, and exchange opinions for collaboration ・Discussion via Internet	
Brian P. Somerday (46)	Dr., Sandia National Laboratories	Ph.D., Materials Science and Engineering	20%	15%	35%	30%	2010, Dec.1st	・Primarily located at partner institution ・Participates in research as Head of Hydrogen Materials Compatibility Division ・Stayed at I^2CNER for two weeks to participate in events and exchange opinions for collaboration ・Participates in meetings/events via videoconference system	・Accepting researchers from I^2CNER

Setsuo Takaki (62)	Prof., International Institute for Carbon-Neutral Energy Research, Kyushu University	Dr. of Engineering	90%	10%	0%	0%	2011, April.1st	・Located at I^2CNER ・Participates in research/events	
Reiner Kirchheim (71)	Prof., The Institut für Metallphysik, University of Göttingen	Ph.D., Hydrogen in Metals, Thermodynamics of alloys, Interstitial solution and diffusion in glasses	20%	20%	40%	20%	2011, April.1st	・Primarily located at partner institution ・Participates in research ・Stayed at I^2CNER for one week to participate in events and exchange opinions for collaboration ・Discussion via Internet	
Miho Yamauchi (41)	Associate Prof., International Institute for Carbon-Neutral Energy Research, Kyushu University	Dr. of Science, Chemistry	100%	0%	0%	0%	2012, Jan. 1st	・Located at I^2CNER ・Participates in research/events ・Hosted a student from UIUC	
Ken Sakai (53)	Prof., Department of Chemistry Faculty of Sciences, Kyushu University	Ph.D., Inorganic Chemistry	80%	10%	0%	10%	2012, Jan.16th	・Located at I^2CNER ・Participates in research/events	
Ian Robertson (57)	Prof., Dean of Engineering, University of Wisconsin-Madison, Chief Science Advisor to the Director	Ph.D., Metallurgy	20%	5%	25%	50%	2012, April.1st	・Primarily located at partner institution ・Participates in research/events as Chief Science Advisor to the Director ・Serves as a member of the Illinois Satellite Advisory Committee ・Visited I^2CNER for one week to participate in events and exchange opinions for collaboration ・Discussion via Internet	・Sent graduate students to Institute

Andrew A. Gewirth (55)	Prof., Chemistry, University of Illinois	Ph.D., Chemistry	20%	5%	60%	15%	2012, April.1st	・Primarily located at partner institution ・Participates in research ・Serves as a member of the Illinois Satellite Advisory Committee ・Visited I^2CNER for one week to participate in events and exchange opinions for collaboration ・Discussion via Internet	
Kenneth T. Christensen (41)	Prof. , College of Engineering, University of Notre Dame	Ph.D., Theoretical and Applied Mechanics specializing in experimental fluid mechanics	20%	5%	60%	15%	2012, April.1st	・Primarily located at partner institution ・Participated in research/events as Associate Director of the Illinois Satellite (until August 2014) ・Serves as a member of the Illinois Satellite Advisory Committee ・Visited I^2CNER for three weeks to participate in events and exchange opinions for collaboration ・Discussion via Internet	・
Shigenori Fujikawa (44)	Associate Prof., International Institute for Carbon-Neutral Energy Research, Kyushu University	Dr. of Eng., Nanoscience and engineering	100%	0%	0%	0%	2013, June.1st	・Located at I^2CNER ・Participates in research/events as Head of CO_2 Capture and Utilization Division	
Takeshi Tsuji (35)	Associate Prof., International Institute for Carbon-Neutral Energy Research, Kyushu University	Dr. of Science, Earth and Planetary Science; Resource engineering; Space exploration	95%	5%	0%	0%	2013, June.1st	・Located at I^2CNER ・Participates in research/events as Head of CO_2 Storage Division	

Researchers unable to participate in project in FY 2014

Name	Affiliation (Position title, department, organization)	Starting date of project participation	Reasons	Measures taken
Tsutomu Katsuki	Prof., International Institute for Carbon-Neutral Energy Research, Kyushu University	2010, Dec.1	Deceased	
Katsuki Kusakabe	Prof., Department of Nanoscience, Sojo University	2010, Dec.1	Appointment changed to WPI Visiting Professor	

Records of FY2014 Center Activities

1. Researchers and center staffs, satellites, partner institutions

1-1. Number of researchers in the “core” established within the host institution

- Enter the total number of people in the columns below. In the “Researchers” column, put the number and percentage of overseas researchers in the < > brackets and the number and percentage of female researchers in the [ ] brackets.
- In the “Administrative staffs” column, put the number and percentage of bilingual staffs in the ( ) brackets.
- In the “Final Goal” column, enter the currently projected goal and the estimated date for achieving it [OO month, OO year].

	Goal set in the ”Post-interim evaluation revised center project”	Results at end of FY 2014	Final goal (Date: March 2020)
Researchers	172 <78, 45%> [29, 17%]	166 <75, 45%> [18, 11%]	177 <81, 46%> [33, 19%]
Principal investigators	25 <9, 36%> [1, 4%]	24 <9, 38%> [1, 4%]	25 <9, 36%> [3, 12%]
Other researchers	147 <69, 47%> [28, 19%]	142 <66, 46%> [17, 12%]	152 <72, 47%> [31, 20%]
Research support staffs	70	56	70
Administrative staffs	21 (17, 81%)	22 (18, 82%)	21 (17, 81%)
Total	263	244	268

<u>Other matters of special mention</u>

- Enter matters warranting special mention, such as concrete plans for achieving the Center’s goals, established schedules for employing main researchers, particularly principal investigators.

As described in Section 5 of the Report, President Kubo envisions that there will to be (10) tenured PIs organically in I^2CNER. The rest of the 10-15 PI positions in I^2CNER (out of the 20-25) will come from either: a) other units of KU through the Intra-University Transfer System (this means that those tenured faculty can return to their original departments after they have spent a reasonable amount of time in I^2CNER), b) through cross-appointments between I^2CNER and other units of KU, e.g. economics, sciences, mathematics, life sciences, etc., or c) through cross-appointments between I^2CNER and its international partner institutes and industry. In addition, the vision is that 3 to 4 PIs amongst the 10 tenured faculty will be non-Japanese. In order to support the recruitment of such distinguished researchers as tenured I^2CNER PIs from abroad, Kyushu University has recently introduced in its Education and Research Council the new Merit-based Annual Salary System, which allows for these foreign faculty to be compensated with a competitive salary, according to international standards. Lastly, apart from the PI categories (a), (b), and (c) above, following the Institute’s policy on Faculty Fellows, I^2CNER will host Faculty Fellows at the PI level.

As of March 31, 2015, we are conducting open recruitment campaigns to hire 2 foreign tenured PIs (our goal is for one of the positions to be filled by a female, if possible), and several tenured faculty members (Japanese or non-Japanese, either full professor or associate professor). These campaigns will close on May 29, 2015 and June 30, 2015, respectively.

- As background to how the Center is working to mobilize/circulate the world's best brains, give good examples, if any, of how career paths are being established for the Center's researchers; that is, from which top-world research institutions do researchers come to the Center and to which research institutions do the Center's researchers go, and how long are their stays at those institutions.

(Listed chronologically, as of March 31, 2015)

Researcher	Position at I^2CNER	Affiliated with I^2CNER for:	Former Affiliation	Affiliation after I^2CNER
Keigo Kitamura	Assistant Professor	4 years and 3 months	Research Institute of Innovative Technology for the Earth, Japan	(Currently at I^2CNER)
Aleksandar Staykov	Assistant Professor (1), Associate Professor (2)	3 years and 7 months (1), 5 months (2)	Kyushu University, Japan	(Currently at I^2CNER)
Junko Matsuda	Assistant Professor	4 years	National Institute of Advanced Industrial Science and Technology, Japan	(Currently at I^2CNER)
Shao Huaiyu	Assistant Professor	3 years and 11 months	Max-Planck, Germany	(Currently at I^2CNER)
Stephen Lyth	Assistant Professor	3 years and 10 months	Tokyo Institute of Technology, Japan	(Currently at I^2CNER)
Kiminori Shitashima	Associate Professor	3 years and 10 months	Central Research Institute of Electric Power Industry, Japan	(Currently at I^2CNER)
Shigenori Fujikawa	Associate Professor	3 years and 5 months	Institute of Chemical and Physical Research, Japan	(Currently at I^2CNER)
Miho Yamauchi	Principal Investigator, Associate Professor	3 years and 3 months	Hokkaido University, Japan	(Currently at I^2CNER)
John Druce	Postdoctoral Researcher	3 years and 3 months	Imperial Collage of London, UK	(Currently at I^2CNER)
Takeshi Tsuji	Associate Professor	3 years	Kyoto University, Japan	(Currently at I^2CNER)
Masaaki Sadakiyo	Assistant Professor	3 years	Kyoto University, Japan	(Currently at I^2CNER)
Arnaud Macadre	Postdoctoral Researcher	3 years	Kyushu University, Japan	(Currently at I^2CNER)
Nicola Perry	Postdoctoral Researcher(1), Assistant Professor (2)	2 years (1), 7 months (2)	Northwestern University, USA	(Currently at I^2CNER)
Chungsik Kim	Postdoctoral Researcher	2 years and 6 months	Kyushu University, Japan	(Currently at I^2CNER)
Ikuo Taniguchi	Associate Professor	2 years and 4 months	Research Institute of Innovate Technology for the Earth, Japan	(Currently at I^2CNER)
Limin Guo	Postdoctoral Researcher	2 years and 4 months	Tohoku University, Japan	(Currently at I^2CNER)
Wei Ma	Postdoctoral Researcher	2 years and 4 months	Kyushu University, Japan	(Currently at I^2CNER)
Motonori Watanabe	Assistant Professor	2 years and 3 months	Institute of Chemistry, Academic Sinica, Taiwan	(Currently at I^2CNER)
Ki-Seok Yoon	Associate Professor	2 years and 2 months	Kyushu University, Japan	Currently at I^2CNER)
Kenshi Itaoka	Professor	2 years and	Mizuho Information &	(Currently at I^2CNER)

		1 month	Research Institute. Inc., Japan	
Hoda Sadat Emami Meibody	Postdoctoral Researcher	2 years	CNRS, France	(Currently at I^2CNER)
Alexander Rene Parent	Postdoctoral Researcher	2 years	Yale University, USA	(Currently at I^2CNER)
Kaveh Edalati	Postdoctoral Researcher	2 years	Kyushu University, Japan	(Currently at I^2CNER)
Fei Jiang	Postdoctoral Researcher	2 years	Kyushu University, Japan	(Currently at I^2CNER)
Mohamed Reda Berber	Postdoctoral Researcher	2 years	Kyushu University, Japan	(Currently at I^2CNER)
Kwati Leonard	Postdoctoral Researcher	1 year and 6 months	Kyushu University, Japan	(Currently at I^2CNER)
Daniel Orejon	Postdoctoral Researcher	1 year and 6 months	University of Edinburgh, UK	(Currently at I^2CNER)
Roman Selyachyn	Postdoctoral Researcher	1 year and 3 months	University of Kitakyushu, Japan	(Currently at I^2CNER)
Biao Shen	Postdoctoral Researcher	1 year and 2 months	Kyushu University, Japan	(Currently at I^2CNER)
Sho Kitano	Postdoctoral Researcher	1 year	Kinki University, Japan	(Currently at I^2CNER)
Tatsunori Ikeda	Postdoctoral Researcher	1 year	Kyoto University, Japan	(Currently at I^2CNER)
Kevin White	Postdoctoral Researcher	1 year	Kyushu University, Japan	(Currently at I^2CNER)
Hideaki Komiyama	Postdoctoral Researcher	1 month	Tokyo Institute of Technology, Japan	(Currently at I^2CNER)
Pravakaran Saravanan	Postdoctoral Researcher	1 months	National University of Singapore, Singapore	(Currently at I^2CNER)
Nobuo Nakada	Assistant Professor	4 years	Kyushu University, Japan	Associate Professor, Tokyo Institute of Technology, Japan
Sean Bishop	Assistant Professor	3 years and 3 months	Massachusetts Institute of Technology (MIT), USA	Research Associate, Massachusetts Institute of Technology (MIT), USA
Xuping Li	Satellite Postdoctoral Researcher	2 years and 3 months	University of California, Davis, USA	Air Resources Engineer, Air Resources Board of the State of California (CARB), USA
Masaru Konno	Postdoctoral Researcher	2 years	Kyushu University, Japan	Researcher, Iwate University, Japan
May Martin	Graduate Research Assistant	2 years	University of Illinois at Urbana-Champaign	Humboldt Fellow, University of Göttingen, Germany
Maki Matsuka	Lecturer (1), Associate Professor (2)	4 months (1), 1 year (2)	Kyushu University, Japan	Researcher, National Institute of Advanced Industrial Science and Technology, Japan
Yuki Naganawa	Postdoctoral Researcher	1 year and 2 months	Kyoto University, Japan	Assistant Professor, Nagoya University, Japan
Shuai Wang	Postdoctoral Researcher	1 year and 2 months	Hokkaido University, Japan	Postdoctoral Researcher, University of Wisconsin-Madison, USA
Seiichiro Kimura	Postdoctoral Researcher	1 year	Kyushu University, Japan	Associate, Matsushita Institute of Government and Management, Japan
Takeshi Matsumoto	Postdoctoral Researcher	1 year	Hokkaido University, Japan	Assistant Professor, Chuo University, Japan
Ryota Watanabe	Postdoctoral Researcher	11 months	Toyota Central R&D Labs., Inc., Japan	Researcher, National Institute of Advanced Industrial Science and Technology, Japan

Le Zhang	Postdoctoral Researcher	10 months	Tokyo Institute of Technology, Japan	Postdoctoral Researcher, Eindhoven University of Technology, Holland
Ju-Hyung kim	Postdoctoral Researcher	10 months	Kyushu University, Japan	Assistant Professor, Pukyung National University, Korea
Myo Minn	Postdoctoral Researcher	8 months	Kyushu University, Japan	Postdoctoral Researcher, Singapore University of Technology and Design, Singapore

1-2. Satellites and partner institutions

- List the satellite and partner institutions in the table below.
- Indicate newly added and deleted institutions in the "Notes" column.
- If satellite institutions have been established, describe by satellite the Center's achievements in coauthored papers and researcher exchanges in Appendix 4.

<Satellite institutions>

Institution name	Principal Investigator(s), if any	Notes
University of Illinois at Urbana-Champaign (UIUC)	Andrew Gewirth	

< Partner institutions>

Institution name	Principal Investigator(s), if any	Notes
Air Resources Board of the State of California (CARB)		Newly added (Letter of Understanding, signed)
Bandung Institute of Technology		
Dalian Institute of Chemical Physics		
Department of Energy, Energy Efficiency and Renewable Energy		
Helmholtz Zentrum Geesthacht (HZG)		Newly added (Agreement underway)
Imperial College London	John Kilner	
Massachusetts Institute of Technology	Harry Tuller	
Max-Planck Institute		
Mohawk Innovative Technology		
Norwegian University of Science and Technology (NTNU)/SINTEF		
Sandia National Laboratories	Brian Somerday	
Swiss Federal Institute of Technology Zurich (ETH)		
Tsinghua University	Xing Zhang	
Universiti Teknologi Malaysia		
University of Bergen		
University of California at Berkeley		
University of California at		

Irvine/NFCRC		
University of Göttingen	Reiner Kirchheim	
University of Norte Dame	Kenneth Christensen	Newly added
University of Oxford		
University of Texas at Austin		
University of Thessaly		
University of Wisconsin-Madison	Ian Robertson	

2. Securing competitive research funding

- Competitive and other research funding secured in FY2014:

Total: 2,883,991,176 yen

- Describe external funding warranting special mention. Include the name and total amount of each grant.

COMPETITIVE FUND			
RECIPIENT	NAME OF GRANT	FUNDED BY:	TOTAL (Yen)
Joichi Sugimura	R&D Project (Useful Technology of Hydrogen)	NEDO	828,346,000
Chihaya Adachi	Exploratory Research for Advanced Technology (ERATO)	JST	253,800,000
Seiji Ogo	KAKENHI (Specially Promoted Research)	JSPS	174,800,000
Kazunari Sasaki	The Center of Innovation (COI) Program	MEXT	126,960,000

COMPETITIVE FUND				
RECIPIENT	NAME OF GRANT	FUNDED BY:	PERIOD	TOTAL (Yen)
Nicola Perry	KAKENHI (Young Researcher B)	JSPS	FY 2013-14	2,470,000
	Enhancement of fuel cell electrode kinetics by control of Fermi level			
Miho Yamauchi	KAKENHI (Scientific Research B)	JSPS	FY 2013-15	18,590,000
	Development of highly active iron-group catalysts by precise alloy-structure control			
Xing Zhang	KAKENHI (Scientific Research B)	JSPS	FY 2013-15	18,720,000
	Experimental study on ballistic thermal characteristics of an individual SWCNT and its application in nanofluids			
Shigenori Fujikawa	KAKENHI (Scientific Research B)	JSPS	FY 2014-16	16,250,000
	Large scale fabrication of Au nanofin array for efficient trapping near-infrared light			
Masamichi Nishihara	KAKENHI (Scientific Research C)	JSPS	FY 2014-16	4,940,000
	Development and structural and functional evaluation of charge-transfer complex hybrid films with various electron-donating molecules			
Hiroshige Matsumoto	KAKENHI (Challenging Exploratory Research)	JSPS	FY 2014-15	3,900,000
	Water electrolysis using water-absorbing porous electrolyte cell for oxygen production under micro gravity			
Masaaki Sadakiyo	KAKENHI (Young Researcher B)	JSPS	FY 2014-16	3,510,000
	Development of ionic conductivity of hydroxide ion-including metal-organic frameworks prepared by salt inclusion			
Motonori Watanabe	KAKENHI (Young Researcher B)	JSPS	FY 2014-15	4,030,000
	Synthesis of alcohol soluble indigo and O2 sensor application			
Guo Limin	KAKENHI (Young Researcher B)	JSPS	FY 2014-15	4,030,000
	Dye-sensitized mesoporous Ta3N5 photocatalysts for water splitting under visible light with longer wavelengths up to ~600 nm			
Sean Bishop	KAKENHI (Young Researcher B)	JSPS	FY 2014-15	3,900,000

	Development of Si impurity tolerant SOFC electrodes using reactive additives			
Mohamed Reda Berber	KAKENHI (Young Researcher B)	JSPS	FY 2014-15	4,030,000
	A step towards the real world application of polymer electrolyte fuel cells: improvement of durability			
Yuki Honda	KAKENHI (Young Researcher B)	JSPS	FY 2014-15	3,900,000
	Mechanism Analysis and Improvement of Fluorescence Changes of the Green Fluorescent Protein-based Citrate Indicators			
Miho Yamauchi	CREST	JST	FY 2012-15	31,206,500 (FY2014)
	Development of highly selective nanoalloy catalysts for the realization of carbon-neutral energy cycles			
Tsutomu Katsuki (Tatsuya Uchida)	ACT-C	JST	FY 2012-15	14,300,000 (FY2014)
	Development of efficient methods for asymmetric carbon-carbon bond formation			
Hiroshige Matsumoto	ALCA	JST	FY 2013-19	72,213,000
	Novel steam electrolysis			
Hiroshige Matsumoto	SIP	JST	FY 2014-18	48,750,500
	Novel steam electrolysis			
Ikuo Taniguchi	ALCA	JST	FY 2014-15	4,550,500
	Advanced Low Carbon Technology Research and Development Program, Preparation of nanogel immobilized membranes and the CO2 separation properties			

COMMISIONED RESEARCH

RECIPIENT	FUNDED BY:	PERIOD	TOTAL (Yen)
Ikuo Taniguchi	RITE	FY 2014	3,024,000
	Development of novel catalysts assisting bicarbonate formation reaction		
Masanobu Kubota	Air Liquid Laboratories	FY 2014-15	7,509,000
	Research and Development on Welded Joints of a High-Nitrogen and High-Strength Stainless Steel Tube for High-Pressure Hydrogen Gas		
Kenshi Itaoka	Quintessa (note: research consulting firm in Yokohama)	FY 2014-15	7,509,000
	Research on public understanding of CCS		
Kenshi Itaoka	TOYOTA	FY 2014	3,486,587
	Research for domestic hydrogen station deployment model		
Kiminori Shitashima	University of Tokyo	FY 2014	16,173,710
	Ocean resource use promotion technical development program, Development of large-area survey system for discovery for ocean mineral resources		

JOINT RESEARCH

RECIPIENT	FUNDED BY:	PERIOD	TOTAL (Yen)
Hiroshige Matsumoto	MITSUI KINZOKU (MINING & SMELTING)	FY 2013-14	679,740
	Development of high-ion-conducting solid electrolyte operating at low temperature		
Hiroshige Matsumoto	TOYOTA	FY 2013-14	5,405,600
	Joint research on the development of high performance electrodes for SOFC		
Petros Sofronis	JFE Steel	FY 2014-15	2,040,000
	Effect of Hydrogen on Fatigue S-N Curves (Co-researcher: Masanobu Kubota)		
Hiroshige Matsumoto	Panasonic	FY 2014	2,000,000
	Joint research on the development of high proton conducting metal oxides		
Masanobu Kubota	Nippon Steel & Sumitomo Metal Corporation	FY 2014-15	1,944,000
	Fundamental Studies on Fretting Fatigue and Crack Growth Behavior of Small Crack		

Hiroshige Matsumoto	Panasonic	FY 2014	2,160,000
	Joint research on epitaxially-prepared high-proton-conducting thin film metal oxides		
Takeshi Tsuji	Shikoku Research Institute	FY 2014	600,000
	Q-value estimation around the fault using P-S logging data		
Tsutomu Katsuki (Tatsuya Uchida)	Nissan Chemical Industries	FY 2014	7,000,000
	Construction of new strategy for environmentally friendly catalytic organic transformation		
Hiroshige Matsumoto	KYOCERA	FY 2014-15	2,850,000
	Research on low-temperature sintering of ceramic materials		
Miho Yamauchi	Toyota Central R&D Labs	FY 2014	1,000,000
	Synthesis of homogeneous solid-solution Fe-Ni nanoalloys for sensor applications		
Hiroshige Matsumoto	Honda	FY 2014-15	1,000,000
	Development of novel hydrogen production method		
Masanobu Kubota	Air Liquid Laboratories	FY 2014-15	20,400,000
	Effect of Impurities Contained in Hydrogen Gas on Inhibition of Hydrogen Embrittlement in Steels (Co-researcher: Alex Staykov)		
Ikuo Taniguchi	Tokyo Boeki Mechanics	FY 2014	1,445,000
	Development of novel CO2 separation membranes with progressive CO2 separation properties		

3. International research conferences or symposiums held to bring world's leading researchers together

- Indicate the number of international research conferences or symposiums held in FY2014 and give up to three examples of the most representative ones using the table below.

FY 2014: 6 meetings

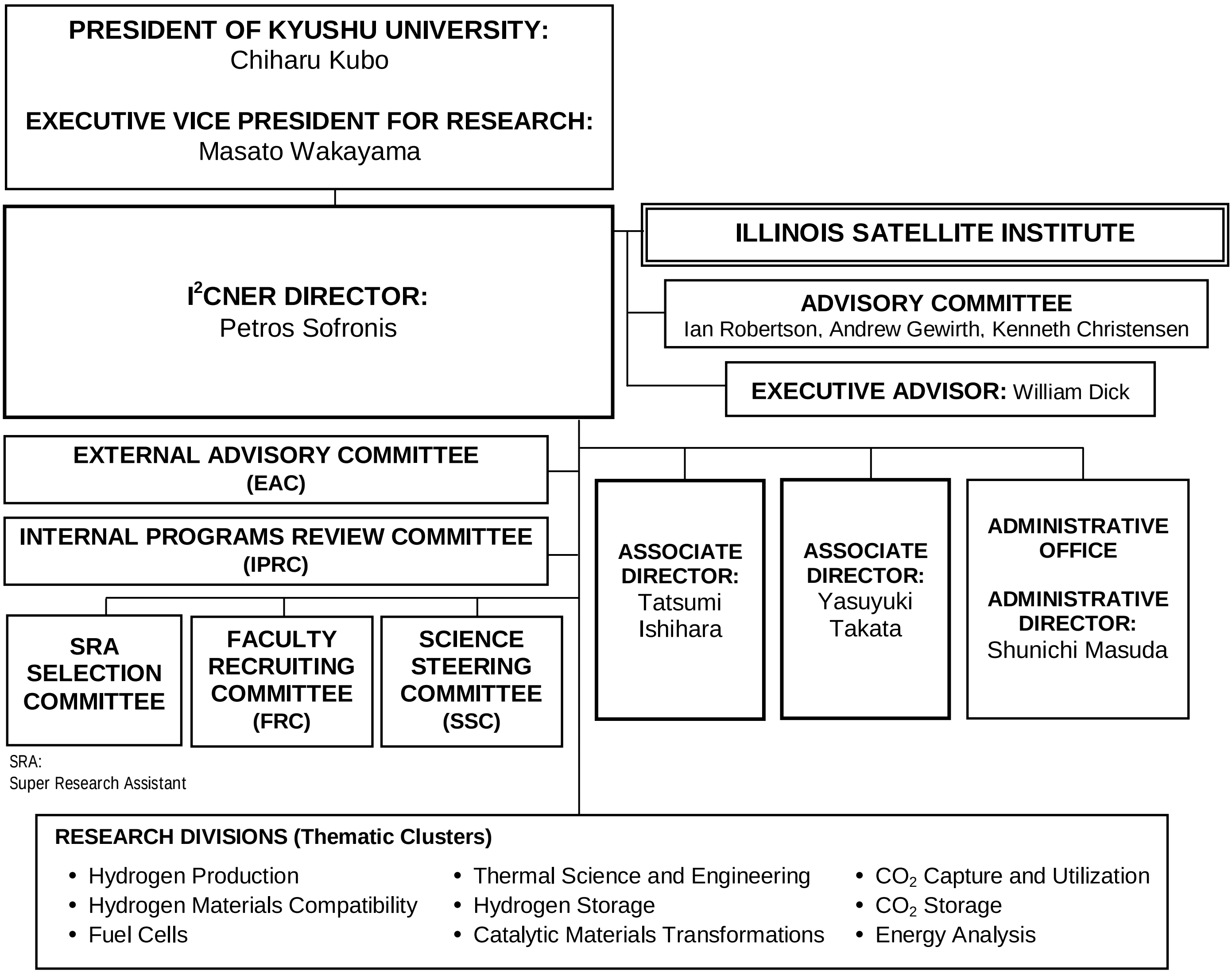
Major examples (meeting title and place held)	Number of participants
I^2CNER Tokyo Symposium TKP Garden City Shinagawa, Tokyo	From domestic institutions: 98 From overseas institutions: 27
I^2CNER Annual Symposium 2015 I^2CNER Hall, Ito Campus, Kyushu University	From domestic institutions: 79 From overseas institutions: 62
I^2CNER International Workshop 2015 Ito Campus, Kyushu University	From domestic institutions: 321 From overseas institutions: 83

4. Center's management system

- Please diagram management system in an easily understood manner.

I^2CNER ORGANIZATIONAL STRUCTURE

(As of April 1, 2015)



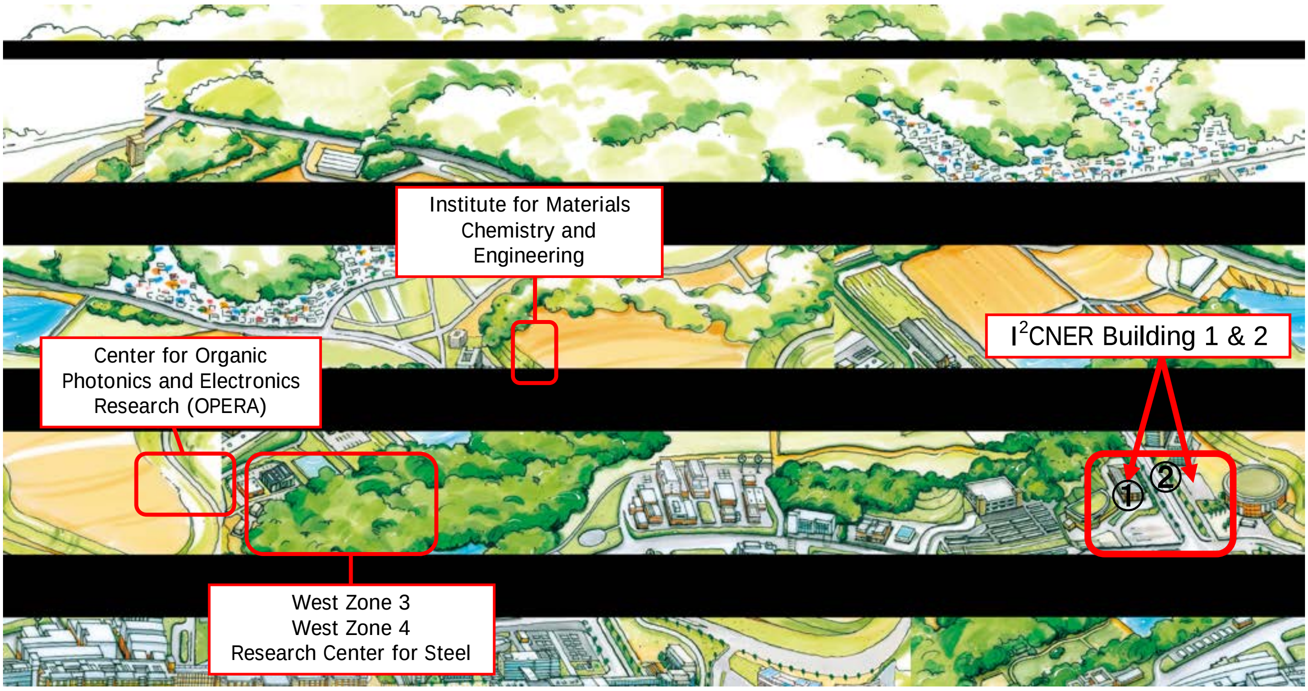
- If any changes have been made in the management system from that in the "Post-interim evaluation revised center project," please describe them. Please describe any changes made in the administrative director, head of host institution, and officer(s) in charge at the host institution (e.g., executive vice president for research)

As of October 1, 2014, Professor Chiharu Kubo replaced Professor Setsuo Arikawa as President of Kyushu University. The new Executive Vice President for Research and Industrial Collaboration, Professor Masato Wakayama oversees I^2CNER's interactions with all of Kyushu University. Executive Vice President Reiko Aoki interacts with I^2CNER on international collaborations and visibility of both I^2CNER and Kyushu University.

Beginning April 1, 2015, Shunichi Masuda joined I^2CNER as the new Administrative Director, replacing Yukio Fujiki, who resigned from the position as of March 31, 2015. Mr. Masuda's main function is to administer the affairs of the office to facilitate the operations of the Institute, and provide administrative support to the research personnel.

5. Campus Map

- Please draw a simple map of the campus showing where the main office and principle investigator(s) are located.



6. FY2014 Project Expenditures (the exchange rate used: 1USD=100JPY)

i) Overall project funding

Cost Items	Details	Costs (10,000 dollars)
Personnel	Center director and Administrative director	22
	Principal investigators (no. of persons):16	217
	Other researchers (no. of persons):79	394
	Research support staffs (no. of persons):29	60
	Administrative staffs (no. of persons):25	100
	Total	793
Project activities	Gratuities and honoraria paid to invited principal investigators (no. of persons):60	8
	Cost of dispatching scientists (no. of persons):0	0
	Research startup cost (no. of persons):30	43
	Cost of satellite organizations (no. of satellite organizations):1	214
	Cost of international symposiums (no. of symposiums):3	10
	Rental fees for facilities	264
	Cost of consumables	24
	Cost of utilities	24
	Other costs	173
	Total	759
Travel	Domestic travel costs	18
	Overseas travel costs	52
	Travel and accommodations cost for invited scientists (no. of domestic scientists):33 (no. of overseas scientists):31	24
	Travel cost for scientists on secondment (no. of domestic scientists):3 (no. of overseas scientists):1	1
	Total	95
Equipment	Depreciation of buildings	10
	Depreciation of equipment	1,160
	Total	1,170
Other research projects	Projects supported by other government subsidies, etc.	145
	Commissioned research projects, etc.	1,304
	Grants-in-Aid for Scientific Research, etc.	181
	Total	1,630
Total		4,447

Ten thousand dollars

WPI grant	1,310
Costs of establishing and maintaining facilities	1,766
Establishing new facilities (Building 2) (Number of facilities:5,000m²) Costs paid:	1,765
Repairing facilities (Number of facilities:0m²) Costs paid:	0
Others	1
Cost of equipment procured	1,248
Name of equipment: Ventilation Device for Draft Chamber Number of units:1 Costs paid:	13
Name of equipment:Simultaneous ICP Atomic Emission Spectrometer Number of units:1 Costs paid:	9
Others	1,226

ii) Costs of Satellites and Partner institutions

Cost Items	Details	Costs (10,000 dollars)
Personnel	Principal investigators (no. of persons):3	
	Other researchers (no. of persons):6	
	Research support staffs (no. of persons):21	
	Administrative staffs	
	Total	147
Project activities		52
Travel		15
Equipment		0
Other research projects		0
Total		214

Status of Collaboration with Overseas Satellites

1. Coauthored Papers
- List the refereed papers published in FY2014 that were coauthored between the center's researcher(s) in domestic institution(s) and overseas satellite institution(s). List them by overseas satellite institution in the below blocks.
- Transcribe data in same format as in Appendix 1. Italicize the names of authors affiliated with overseas satellite institutions.
- For reference write the Appendix 1 item number in parentheses after the item number in the blocks below. Let it free, if the paper is published in between Jan.-Mar. 2015 and not described in Appendix 1.

Overseas Satellite: University of Illinois, Urbana-Champaign (Total: 9 papers)

No.	Author names and details
1- (-)	Robertson, I.M., Sofronis, P., Nagao, A., *Martin, M.L.*, Wang, S., Gross, D.W. a*nd Nygren, K.E.* (2015), Hydrogen embrittlement understood, Metallurgical and Materials Transactions B, 46 (3), 1085-1103
2- (-)	*Dadfarnia, M.*, *Martin, M.L.*, Nagao, A., Sofronis, P. and Robertson, I.M. (2015), Modeling hydrogen transport by dislocations, Journal of the Mechanics and Physics of Solids, 78, 511-525)
3- (13)	Ida, S., Kim, N., *Ertekin, E.*, Takenaka, S. and Ishihara, T. (2014), Photocatalytic Reaction Centers in Two-Dimensional Titanium Oxide Crystals, Journal of the American Chemical Society, 137 (1), 239-244
4- (47)	Téllez, H., Druce, J., Hall, A., Ishihara, T., Kilner, J. and *Rockett, A.* (2015), Low energy ion scattering: Surface preparation and analysis of Cu(In,Ga)Se_2 for photovoltaic applications, Progress in Photovoltaics: Research and Applications, 23 (10), 1219-1227
5- (137)	*Dadfarnia, M.*, Somerday, B. P., Schembri, P.E., Sofronis, P., Foulk III, J.W., Nibur, K.A. and Balch, D.K. (2014), On Modeling Hydrogen-Induced Crack Propagation Under Sustained Load, JOM, 66 (8), 1390-1398
6- (139)	Nagao, A., *Martin, M.L.*, *Dadfarnia, M.*, Sofronis, P. and *Robertson, I.M.* (2014), The effect of nanosized (Ti,Mo)C precipitates on hydrogen embrittlement of tempered lath martensitic steel, Acta Materialia, 74, 244-254
7- (144)	Wang, S., *Martin, M.L.*, Sofronis, P., Ohnuki, S., Hashimoto, N., *Robertson, I.M.* (2014), Hydrogen-induced intergranular failure of iron, Acta Materialia, 69, 275-282
8- (221)	Harish, S., Tabara, M., Ikoma, Y., Horita, Z., Takata, Y., *Cahill, D.G.*, Kohno, M. (2014), Thermal conductivity reduction of crystalline silicon by high-pressure torsion, Nanoscale Research Letters, 9, 326
9- (291)	Kitamura, K., Jiang, F., *Valocchi, A.J.*, Chiyonobu, S., Tsuji, T. and *Christensen, K. T.* (2014), The study of heterogeneous two-phase flow around small-scale heterogeneity in porous sandstone by measured elastic wave velocities and lattice Boltzmann method simulation, Journal of Geophysical Research: Solid Earth, 119 (10), 7564-7577

2. Status of Researcher Exchanges

- Using the below tables, indicate the number and length of researcher exchanges in FY2014. Enter by institution and length of exchange.
- Write the number of principal investigator visits in the top of each space and the number of other researchers in the bottom.

Overseas Satellite: University of Illinois at Urbana-Champaign, USA

<To satellite>

	Under 1 week	From 1 week to 1 month	From 1 month to 3 months	3 months or longer	Total
FY2014	4 6	0 0	0 0	0 0	4 6

<From satellite>

	Under 1 week	From 1 week to 1 month	From 1 month to 3 months	3 months or longer	Total
FY2014	5 9	0 4	0 0	0 0	5 13

FY 2014 Visit Records of World Top-caliber Researchers from Abroad

Researchers Total: 34

Name (Age)	Affiliation (Position title, department, organization)	Academic degree, specialty	Record of research activities (Awards record, etc.)	Time, duration	Summary of activities during stay at center (e.g., participation as principal investigator; short-term stay for joint research; participation in symposium)
Taeghwan Hyeon	Professor, School of Chemical and Biological Engineering, Seoul National University, Korea	Ph. D., Nanostructured Catalytic and Magnetic Materials, Sonochemical Synthesis and Characterization	• Top 100 Chemists of the decade (2000-2010) by UNESCO & IUPAC (ranked at 37th in chemistry area; 19th in Materials Science, 2011)	2014/4/4	I^2CNER Seminar Series Presentation
Harry Tuller	Prof. Department of Materials Science and Engineering, Massachusetts Institute of Technology, USA	Eng. Sc. D., Functional Electroceramic Materials	• Helmholtz International Fellow Award (2012) • Somiya Award of the International Union of Materials Research Society (2012) • Outstanding Achievement Award, High Temperature Division, Electrochemical Society (2010) • Docteur Honoris Causa, University of Oulu, Finland (2009) • McMahon Award, Alfred University, NY (2009) • Orton Award, American Ceramic Society (2008) • FH Norton Award, American Ceramic Society (2007) • Docteur Honoris Causa, University of Provence, Marseille, France (2004) • Von Humboldt Award (1997-2002) • Fulbright Award (1989-1990)	2014/5/31-2014/6/7 2015/1/24-2015/2/12	Joint Research, Participation in Site Visit as Principal Investigator, Division Meetings Joint Research, Participation in I^2CNER Annual Symposium, Hydrogen Forum and International Workshop as Principal Investigator

John Kilner	Prof., Department of Materials, Imperial College, London, UK	PhD., Materials for Solid Oxide Fuel Cells and Electrolysers	• Platinum Medal, Institute of Materials Minerals and Mining (2012) • Somiya Award, International Union of Materials Research Societies (2012) • Royal Society Armourers and Braziers Award, Royal Society (2005) • Schoenbein Medal, European Solid Oxide Forum (2004) • Verulam Medal, Institute Of Materials, Minerals and Mining (2005) • Fellow, City and Guilds Institute of London (2007) • Excellence in Teaching, Imperial College (1997)	2014/5/31-2014/6/14 2014/11/7-2014/11/22 2015/1/24-2015/2/12	Participation in Site Visit, Division Retreat, and Joint Research as Principal Investigator Joint Research Participation in I^2CNER Annual Symposium, Hydrogen Forum and International Workshop, and Joint Research as Principal Investigator
Brian Somerday	Dr., Sandia National Laboratories, USA	Ph.D., Materials Science and Engineering	• DOE Hydrogen and Fuel Cell Program Achievement Award (2014) • Best Poster Award, ASME 12th Fuel Cell Science, Engineering, and Technology Conference (2014)	2014/6/1-2014/6/9 2015/1/31-2015/2/7	Participation in Site Visit, and Division Retreat as Principal Investigator Participation in I^2CNER Annual Symposium, Hydrogen Forum, International Workshop, and Joint Research as Principal Investigator
Kenneth Christensen	Prof., College of Engineering, University of Notre Dame, USA	Ph.D., Theoretical and Applied Mechanics specializing in experimental fluid mechanics	• Dean's Award for Excellence in Research from the College of Engineering, UIUC (2012) • Francois Frenkiel Award for Fluid Mechanics from APS-DFD (2011) • NSF CAREER Award (2007) • AFOSR Young Investigator Award (2006)	2014/6/2-2014/6/6 2014/6/2-2014/6/6 2015/2/1-2015/2/5	Participation in Site Visit, and Division Meetings as Principal Investigator Participation in I^2CNER Tokyo Symposium Participation in I^2CNER Annual Symposium, Hydrogen Forum and International Workshop as Principal Investigator

Elif Ertekin	Assistant Prof., Department of Mechanical Science & Engineering, University of Illinois	Ph.D., Materials Science & Engineering	• Materials Research Society Best Poster Award (2005 and 2012) • Intel Corporation Graduate Fellowship (2004-2005) • National Science Foundation Graduate Fellowship (1999-2002) • Xerox Undergraduate Research Award, Penn State University (2000) • Frank Fenlon Undergraduate Thesis Presentation Award, Penn State University (1999)	2014/6/2-2014/6/9	Participation in Site Visit, and Division Retreat as Satellite Faculty Member
Xing Zhang	Prof., Department of Engineering Mechanics, Tsinghua University	Ph.D., Thermal Science	• Significant Contribution Awards from the 10th Asian Thermophysical Properties Conference (2013) • National Nature Science Award (Second Class) from the State Council of the People's Republic of China (2011) • Best Paper Award from the Heat Transfer Society of Japan (2008)	2014/6/3-2014/6/12 2014/7/21-2014/8/16 2015/1/29-2015/2/14	Participation in Site Visit, and Division Meetings as Principal Investigator Joint Research Participation in I^{2}CNER Annual Symposium, International Workshop, and Joint Research as Principal Investigator
Josua Meyer	Professor, University of Pretoria, South Africa	PhD., Mechanical Engineering	• Thomas Price Award (1988)	2014/8/8	I^{2}CNER Seminar Series Presentation
C.N.R. RAO	National Research Professor, Linus Pauling Research Professor, Honorary President, Jawaharlal Nehru Centre for Advanced Scientific Research, India	D.Sc., Ph.D., Solid State and Materials Chemistry, Structural Chemistry	• International Award (Gold Medal) of the Chinese Academy of Sciences (2012) • The Royal Medal (Queen's Medal), by the Royal Society, London, U.K (2009) • Chemical Pioneer, American Institute of Chemists (2005)	2014/8/25	I^{2}CNER Seminar Series Presentation

			• Somiya Award of the International Union of Materials Research Society (IUMRS) (2004)		
Shahrum Abdullah	Professor, Universiti Kebangsaan Malaysia, Malaysia	Ph.D., Mechanical Engineering, Fatigue Life Assessment	• Bronze Medal in the World Design Exhibition (2007) • Second Best Paper Award, National Conference on Design and Concurrent Engineering (2006) • Gold Medal in the Design Competition, 17th ITEX (2006) • Best Paper Award for the 12th International Conference in Experimental Mechanics (ICEM12) (2004)	2014/9/5	I^2CNER Seminar Series Presentation
Xavier Sauvage	Research Scientist, CNRS (National Center for Scientific Research), France	Ph.D., Material Science	• FEMS Young Lecturer Award, Federation of European Materials Societies (2010)	2014/9/12	I^2CNER Seminar Series Presentation
Ruzhu Wang	Professor, Shanghai Jiao Tong University, China	Ph.D., Refrigeration and Cryogenics	• Second National Award of Invention for the Advancement of Science and Technology (2010)	2014/9/12	I^2CNER Seminar Series Presentation
Satish Kandlikar	Gleason Professor of Mechanical Engineering, Rochester Institute of Technology, USA	Ph.D., Electronics Cooling	• 2012 Heat Transfer Memorial Award, Heat Transfer Division, ASME	2014/10/24	I^2CNER Seminar Series Presentation
Sylviane Sabo-Etienne	CNRS Research Director, Universite de Toulouse, France	Ph.D., Organometallic Chemistry, Catalysis, Coordination Chemistry	• RSC Frankland Award (2010) • Glenn T. Seaborg Memorial Lecturer, the University of California, Berkeley (2010)	2014/10/31	I^2CNER Seminar Series Presentation

Thomas McCarthy	Professor, Department of Polymer Science and Engineering, University of Massachusetts, USA	Ph.D., Organic Chemistry	• Univ of Mass "Milestone Award" (2006) • Univ of Mass "Centennial Award - Outstanding Faculty Member" (2008) • Univ of Mass "Outstanding Accomplishments in Research and Creative Activity" (2008)	2014/11/7	I^2CNER Seminar Series Presentation
Curtis Berlinguette	Professor, University of British Columbia, Canada	Ph.D., Solar Cells, Solar Fuels, Energy Storage, Catalysis	• Alfred P. Sloan Research Fellow (2011)	2014/11/21	I^2CNER Seminar Series Presentation
Thomas Meyer	Arey Distinguished Professor of Chemistry, University of North Carolina at Chapel Hill, USA	Ph.D., Solar Energy Conversion, Artificial Photosynthesis	• Samson Prime Minister's Prize for Innovation in Alternative Fuels for Transportation (2014) • Honda-Fujishima Lectureship Award (2013)	2014/12/1	I^2CNER Seminar Series Presentation
Cyrus Wadia	Assistant Director, Clean Energy & Materials R&D, White House Office of Science and Technology Policy, USA	Ph.D. Energy and Resources	• World Top Young Innovator Award (MIT Technology Review TR35), (2009) • DOE Entrepreneur In Residence Grant (2009) • 1st Place Research Competition, B.E.R.C Symposium (2008)	2014/12/11-2014/12/15	Participation in I^2CNER Tokyo Symposium
Peng Zhang	Professor, Shanghai Jiao Tong University, China	Ph. D., Thermal Energy Storage, Heat Transfer and Fluid Flow, CO_2 Capture and Storage	• Young Investigator Award, Chinese Society of Engineering Thermophysics (2012) • Young Scientist Award, Chinese Association of Refrigeration (2007)	2015/1/23	I^2CNER Seminar Series Presentation
Scott Barnett	Prof., Northwestern University, USA	Ph.D. Metallurgy	• Fellow, American Vacuum Society (1998) • Department Teacher of the Year (1993)	2015/2/1-2015/2/3	Participation in I^2CNER Annual Symposium

Kevin Nibur	Principal, Hy-Performance Materials Testing, LLC., USA	Ph.D. Professional Engineer	• Owner of Hy-Performance Materials Testing, LLC.	2015/2/1-2015/2/5	Participation in I^2CNER Annual Symposium, Hydrogen Forum and International Workshop
Minghui Yang	Prof., Dalian Institute of Chemical Physics, Chinese Academy of Science, China	Ph.D. Materials Chemistry	• China National "Thousand Youth Talents" Award for Distinguished Professorship (2013)	2015/2/1-2015/2/5	Participation in I^2CNER Annual Symposium, Hydrogen Forum and International Workshop
Ian Robertson	Prof., Dean of Engineering, University of Wisconsin-Madison, Chief Science Advisor to the Director	Ph.D., Metallurgy	• ASM Edward DeMille Campbell Memorial Lecturer (2014) • Donald Burnett Teacher of the Year Award (1992) • DOE Award (with H. K. Birnbaum) for Outstanding Scientific Accomplishment (1984)	2015/2/1-2015/2/5	Participation in I^2CNER Annual Symposium, Hydrogen Forum and International Workshop as Principal Investigator
Andrew Gewirth	Prof., Chemistry, University of Illinois	Ph.D., Chemistry	• University of Illinois Scholar (1995) • Alfred P. Sloan Fellowship (1993) • DOE Outstanding Accomplishment in Materials Science (1993) • Fellow, UIUC Center for Advanced Study (1991) • Presidential Young Investigator Award (1990)	2015/2/1-2015/2/6	Participation in I^2CNER Annual Symposium, Forum and International Workshop as Principal Investigator
Jack Brouwer	Assoc. Prof., National Fuel Cell Research Center, University of California, Irvine, USA	Ph.D. Mechanical Engineering	• Honored Member, International Who's Who of Professionals (2006)	2015/2/1-2015/2/6	Participation in I^2CNER Annual Symposium, Division Retreat and Division Symposium
Joan Ogden	Prof., University of California, Davis, USA	Ph.D. Theoretical Plasma Physics	• R&D Excellence Awards, DOE (2005-2006)	2015/2/1-2015/2/6	Participation in I^2CNER Annual Symposium, Hydrogen Forum, International Workshop and Research Discussion
Yuying Yan	Prof., University of Nottingham, UK	Ph.D. Mechanical Engineering	• Reported by Royal Society's Excellence • Supported by the UK EPSRC, Royal Society, Royal Academy of	2015/2/1-2015/2/6	Participation in I^2CNER Annual Symposium, Hydrogen Forum, International Workshop, and Division Symposium

			Engineering, European FP7 and industries		
Reiner Kirchheim	Prof., The Institut für Metallphysik, University of Göttingen, Germany	Ph.D., Hydrogen in Metals, Thermodynamics of Alloys, Interstital Solution and Diffusion in Glasses	• Leibniz-Medaille of the IFW Dresden (2013) • Hydrogen & Energy Award, H&E-Symposium (2010) • Lee Hsun Lecture Award, IMR Shenyang, Chinese Academy of Sciences (2007) • International Award of Materials Engineering for Recourses, Akita, Japan (2005) • Heyn-Denkmünze (highest award of the German Materials Society, DGM) (2004) • Honda Memorial Award, Tohoku University (2003) • Highly Cited Author in Materials Science (1980-2000) • Carl Wagner Prize (1990) • Scripta Metallurgica Outstanding Paper Award (1987)	2015/2/1-2015/2/7	Participation in I^{2}CNER Annual Symposium, Hydrogen Forum and International Workshop as Principal Investigator
Jürgen Fleig	Prof., Vienna University of Technology, Austria	Ph.D. Chemistry	• Edward C. Henry Award, American Ceramic Society (2005) • Tajima-Prize, International Society of Electrochemistry (2004)	2015/2/2, 2/5	Participation in I^{2}CNER Annual Symposium and Division Symposium
Christopher Pickett	Prof., University of East Anglia, England	Ph.D. Chemistry	• RSC Ludwig Mond Award (2009)	2015/2/2-2015/2/7	Participation in I^{2}CNER International Workshop , Hydrogen Forum and Research Discussion
May-Britt Hägg	Prof., Norwegian University of Science and Technology, Norway	Ph.D. Chemical Engineering	• Participation in 8 EU-projects since mid 1990 • Heading several national projects with grants from Norwegian Research Council	2015/2/3-2015/2/5	Participation in I^{2}CNER International Workshop

Michael Felderhoff	Max-Planck Institute for Kohlenforschung, Germany	Ph.D., Chemistry	• Expert of the International Energy Agency (IEA) Task 32 "Hydrogen-based energy storage" of the Hydrogen Implementation Agreement since 2013	2015/2/3-2015/2/6	Participation in I^{2}CNER International Workshop and Research Discussion
Rodney Ruoff	Professor, Ulsan National Institute of Science and Technology, Korea	Ph.D., Global environment and energy	• Lee Hsun Lecture Award, Institute of Metal Research, Chinese Academy of Sciences (2009) • 16th most cited materials scientist of top 100 most cited	2015/2/13	I^{2}CNER Seminar Series Presentation
David Smith	Regents' Professor, Department of Physics, Arizona State University, USA	D.Sc., Ph.D., Electron Microscopy and Materials Physics	• Helmholtz International Fellow Award (2014) • Distinguished Physical Scientist Award, Microscopy Society of America (2014)	2015/3/6	I^{2}CNER Seminar Series Presentation

State of Outreach Activities

- Using the table below, show the achievements of the Center's outreach activities in FY2014(number of activities, times held).
- Describe those activities that have yielded novel results or that warrant special mention in the "Special Achievements" space below.
- In appendix 7, list and describe media coverage (e.g., articles published, programs aired) in FY2014 resulting from press releases and reporting.

Activities	FY2014 (number of activities, times held)
PR brochure, pamphlet	5
Lectures, seminars for general public	14
Teaching, experiments, training for elementary and secondary school students	16
Science café	1
Open houses	1
Participating in, exhibiting at events	5
Press releases	14

Special Achievements

Super Science High Schools (SSH) Student Workshop
- Prof. Takeshi Tsuji gave a lecture for students. (August 7, 2014)

European Materials Research Society (E-MRS) 2014 Spring Meeting
- Director Sofronis, Prof. Ken Sakai and Prof. Adachi gave lectures at the workshop, jointly organized by 4 WPI institutes (AIMR, iCeMS, MANA, and I^2CNER). (May 28, 2014)

Kyushu University Homecoming Day
- I^2CNER hosted over 60 Kyushu University alumni for a facility tour. (October 18, 2014)

4th WPI Joint Symposium
- Prof. Aleksandar Staykov gave a lecture. (December 13, 2014)

Books for general readers
- Prof. Seiji Ogo published "The Story of Hydrogen Energy." (December 2014)

Kyushu University Soft Engineering Open Lecture 2015
- Prof. Yamauchi and Prof. Taniguchi gave lectures for general public. (January 24, 2015)

FY 2014 List of Project's Media Coverage

- Select main items of coverage, and list them within these 2 pages.

No.	Date	Type media (e.g., newspaper, television)	Description
1	2014/4/11 2014/9/6 2014/9/8 2014/9/9	Nikkei Shimbun Nishinippon Shimbun Nikkan Kogyo Shimbun Nikkei Sangyo Shimbun	Development of a future-generation of PEFCs using a minimal amount of Pt (Naotoshi Nakashima, Fuel Cells Division)
2	2014/4/29 2014/5/5 2014/5/26	Nishinippon Shimbun Zaikei Shimbun Yomiuri Shimbun	Pore pressure distribution around the seismogenic fault (Takeshi Tsuji, CO_2 Storage Division)
3	2014/5/30 2014/5/31 2014/6/2	Nikkei Technology Online Nishinippon Shimbun Nikkan Kogyo Shimbun	Development of EL devices with 100% of luminous efficiency (Chihaya Adachi, Hydrogen Production Division)
4	2014/6/4 2014/6/5	NHK Yomiuri Shimbun Mainichi Shimbun Nikkei Shimbun	[NiFe]Hydrogenase from Citrobacter sp. S–77 Surpasses Platinum as an Electrode for H_2 Oxidation Reaction (Seiji Ogo, Catalytic Materials Transformations Division)
5	2014/6/5	Nikkei Shimbun	Raising the level of industrial might (Director Sofronis, Hydrogen Materials Compatibility Division)
6	2014/6/27	Kagaku Shimbun	Development of facile strain analysis of largely bending films (Shigenori Fujikawa, CO_2 Capture and Utilization Division)
7	2014/7/3	Mynavi News (Web) Zaikei Shimbun	Vacuum generation by hydrogen permeation to atmosphere (Yasuyuki Takata, Thermal Science and Engineering Division)
8	2014/9/29	Denki Shimbun Nikkan Kogyo Shimbun Nikkei Shimbun	World-first experiment on a controlled sub-seabed CO_2 leak demonstrates minimal environmental impact and rapid recovery (Kiminori Shitashima, CO_2 Storage Division)

9	2014/10/6 2014/10/8 2014/10/10 2014/10/10	Zaikei Shimbun Nikkei Sangyo Shimbun Nikkan Kogyo Shimbun Kagaku Shimbun	Semiconducting carbon nanotube sorting (Naotoshi Nakashima, Fuel Cells Division)
10	2014/10/24 2014/10/26	National Institute for Environmental Studies (Web) Zaikei Shimbun	Surface termination and subsurface restructuring of perovskite-based solid oxide electrode materials (Tatsumi Ishihara, John Kilner, John Druce and Hellena Téllez, Hydrogen Production Division)
11	2014/10	Nikkan Tekko Shimbun	Challenge of new automotive materials development (Setsuo Takaki, Hydrogen Materials Compatibility Division)
12	2014/11/10	Japan Times	Time for underground CO_2 storage is now (Ziqiu Xue, CO_2 Storage Division)
13	2014/12/15	Television Nishinippon Corporation (TNC)	Short interview: (Stephen Lyth, Fuel Cells Division)
14	2015/1	NHK Fukuoka	Short interview about her research, I^2CNER, and what it's like to be an international researcher at KU (Nicola Perry, Fuel Cells Division)
15	2015/2/14	Mainichi Shimbun	Effect of molecular motion on carrier formation in a poly (3-hexylthiophene) film (Keiji Tanaka, Hydrogen Production Division)
16	2015/2/20	NHK Fukuoka	Development of long lifetermoelectric conversion sheet (Tsuyohiko Fujigaya, Fuel Cells Division)
17	2015/2	Economist Seattle Times Washington Times	Wendy Schmidt Ocean Health XPRIZE: selected as Team SINDEN Japan Team Leader (Kiminori Shitashima, CO_2 Storage Division)