RESEARCH REPORT

1. Name: Hanna Eilken (ID No.: SP04301)

2. Current affiliation:

Institute for Stem Cell Research, GSF, Ingolstaedter Landstr. 1, 85764 Munich, Germany

3. Research fields and specialties:

☐ Humanities ☐ Social sciences ☐ Mathematical and Physical Sciences
☐ Chemistry ☐ Engineering Sciences X Biological Sciences
☐ Agricultural Sciences ☐ Medical, Dental and Pharmaceutical Sciences
☐ Interdisciplinary and Frontier Sciences

4. Host institution: RIKEN Institute for Developmental Biology, Kobe

5. Host researcher: Shin-Ichi Nishikawa

6. Description of your current research

Blood development occurs in two waves in mammalian embryos. In the yolk sac the first blood cells are produced, mainly primitive erythrocytes that supply the growing embryo with oxygen. Later, the site of blood cell production shifts to the a special region within the embryo where the aorta is formed. The blood cells generated there develop from endothelial cells which coat the blood vessels. According to the current idea the hematopoietic progenitors bud from the endothelial cells and are released in the lumen of the vessel. During their generation from the endothelial cells, blood cells change their morphology and can be identified by loss or expression of different surface molecules that characterize these different cell types. Cells that emerge from that process then colonize liver, thymus and spleen and eventually the bone marrow to establish the base for the adult blood system and give rise to all blood cells throughout the life.

Despite its scientific importance, it is unknown how this transition is exactly proceeding at the cellular level. One possible mechanism, which allows to generate cell types with different properties from multipotent progenitors is asymmetric cell division – a cell division which generates two different daughter cells. Within my thesis, I will analyze if asymmetric cells division is involved in the generation of blood cells from endothelial cells and which molecular mechanisms are part in this process. There are several proteins that play an important role in the control of asymmetric cell division of other cell types like nerve cells. Their possible role in the hematopoietic system will be investigated.

7. Research implementation and results under the program (As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Analysis of the involvement of asymmetric cell division in hematopoietic transition of embryonic stem cell derived endothelial cells.

Description of the research activities:

To analyze the molecular mechanisms controlling the development of blood cells from endothelial cells and their possible asymmetric cell division, in vitro models are necessary which allow easy monitoring of this complex biological process. For this study, *in vitro* culture systems are used, which have been established in Dr. Nishikawa's laboratory in Japan. Murine embryonic stem cell lines are cultured under conditions which allow the generation of endothelial cells and subsequently of blood cells in two-dimensional cell cultures in vitro. This development can be followed by time lapse microscopy.

In order to analyze the effect of genes, which are usually involved in asymmetric cell division, on endothelial / hematopoietic transition, it is necessary to induce their expression at specific time points in the used culture system and identify the cells expressing the induced genes. Genes were therefore cloned into expression plasmids behind regulatory sequences allowing to switch on the expression of these genes by activating CRE recombinase. In addition, the expression of the genes is linked to the expression of fluorescent proteins, which easily be detected by fluorescent microscopy.

For using these expression plasmids in the established culture systems, embryonic stem cell lines are necessary which express a CRE recombinase which can be activated at specific time points in the cultures. During my visit in Japan, I therefore generated new mouse embryonic cell lines which activate the CRE protein after induction with Hydroxytamoxifen (OHT). The OHT-inducible CRE-protein was introduced into the cells by transfecting a plasmid encoding a fusion gene of *CRE* and two Hydroxytamoxifen binding domains and a resistance gene for the cytotoxin Puromycin. Cell clones, which integrated the transfected plasmid into their genome ,and stably express the OHT- inducible CRE, were isolated by Puromycin selection. These clones were tested for OHT-inducible CRE activity and positive clones were used for further experiments. While the expressed Puromycin resistance gene was necessary for selection of these clones, it would be disadvantageous for

future experiments. In the second part of the project, the resistance gene, but not the OHT-inducible CRE gene, should therefore again be removed from the selected clones. The Puromycin resistance gene was located between two DNA sequence sites that allow to remove the sequence between them by the FLP recombinase. This FLP recombinase was transiently introduced into the clones and clones were selected which had lost the Puromycin resistance. After identifying embryonic stem cell clones which still express the OHT-inducible CRE, they were expanded and cryopreserved for future use. In addition, the ability of these newly produced clones to generate endothelial and blood cells in the used culture system was successfully verified, and the cell lines can be used for the planned analyses.

In the future, the cloned plasmids containing genes controlling asymmetric cell division will be brought into these cell lines. The expression of the genes will be induced by activating the CRE protein by the addition of OHT to the cultures at specific time points. Analysis of the behavior of the cultures and quantification of blood and endothelial cell production will then allow conclusions about the effect of these genes and a possible involvement of asymmetric cell division in the generation of blood cells from endothelial cell during development.

8. Please add your comments (if any):

To work in Prof Nishikawa′s laboratory gave me the unique possibility to learn the cell culture systems and the techniques connected with that at first hand from people who established the methods in one of the most important stem cell groups in the world . It was a great pleasure and I always felt welcome and supported in every way – not only in the laboratory but also in the life besides of the lab .

Thanks to the JSPS which made that possible. The supporting program and free research is an optimal combination for successful studies and an unforgettable time in Japan.

RESEARCH REPORT

1. Name: Juliane Gabel (ID No.: SP04302)

2. Current affiliation:

Kurt-Schwabe-Institute for measurement and sensor technique e.V. Meinsberg

3. Research fields and specialties:

☐ Humanities ☐ Social sciences ☐ Mathematical and Physical Sciences

☑ Chemistry ☐ Engineering Sciences ☐ Biological Sciences

☐ Agricultural Sciences ☐ Medical, Dental and Pharmaceutical Sciences

☐ Interdisciplinary and Frontier Sciences

4. Host institution:

Art, Science and Technology Center for Cooperative Research (KASTEC), KYUSHU UNIVERSITY

5. Host researcher:

Prof. Norio Miura

6. Description of your current research

My current field of research is material science. I am looking for new materials for solid state electrodes for potentiometric measurement in aqueous and organic solutions, for example measuring pH-value, solved ions or redox potential. Therefore two electrodes are necessary: the sensitive electrode and the reference electrode.
Solid state sensors possess a great importance for chemically analytic measurements in gaseous and liquid phases. Such electrodes are more stable as regards high pressure, high temperature and so on. It is known for quite some time that there is the possibility to use transition metal oxide bronzes to determine several ions in aqueous solutions. Especially molybdenum and tungsten oxide bronzes with the general formula $A_xM_yO_z$ (A = Li, Na, K or the like; M = W or Mo) are used as ion selective materials. Above all there is a good response to H_3O^+ but also to some univalent cations such as Na^+, K^+, Li^+. However some special bronze electrodes possess a behaviour such as electrochemical reference electrodes. These electrodes show no response to the change of pH and redox potential in aqueous solutions but little response to alkali cations.

7. Research implementation and results under the program (As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Structure determination on oxide bronzes

Description of the research activities:

1. Introduction

The compounds $Ba_{0.12}WO_3$ and $Li_{0.4}Mo_{0.95}W_{0.05}O_3$ possess some interesting properties which make them attractive for using in sensor technology. It is known that compounds of the general formula A_xMO_3 (A = element of I, II or III main group, M = transition metal, $0 < x < 1$), called "oxide bronzes" can be used as sensitive electrode material for detecting pH value, the concentration of several metal ions or the redox potential in aqueous solutions. However, electrodes made of the above mentioned special compounds do not show such sensitivities. The electrode potential is independent from changing measurement solutions. For explanation of this opposite behaviour, it is important to have a lot of information about the crystal structure of this compounds. Therefore considerably investigations have been carried out.

2. Research activities

For getting more information about crystal structure different measurement methods have been used: XRD (X-ray Diffraction) at room temperature up to 300 °C, TEM (Transmission Electron Microscopy), XPS (X-ray Photoelectron Spectroscopy) and FT/IR Fourier (Transformed Infrared Spectroscopy). Within the work I learned how to use XPS, FT/IR and high temperature XRD . Also I got information about the interpretation of the results.

- XRD

XRD is a fundamental method in structure analysis. The sample is irradiated with x-rays known wavelength (λ). The diffraction on the lattice follows the BRAGG equation: $2d \sin\theta = n \cdot \lambda$. A characteristic intensity distribution can be detected. This diffraction pattern show the intensity of the reflected radiation in dependence of the reflection angle θ. Using θ it is possible to get the distance between the layers (d). Measurements at higher temperatures can give information about coefficient of expansion and structure transformations.
All measurements have been carried out using a Rigaku X-ray diffractometer with high temperature chamber and RINT2000 goniometer, Cu Kα radiation (40 kV, 20 mA). High temperature measurements were carried out in air.

- TEM

TEM is dedicated to micro structural analysis of solid materials down to the subnanometer scale. TEM is analogous to optical microscopy: the photons are replaced by high-energy electrons (> 100 kV) and the glass lenses by electromagnetic lenses. The electron beam passes an electron-transparent sample and an enlarged image is formed using a set of lenses. TEM gives the possibility to take high resolution pictures and to collect diffraction patterns on small crystals or grains. The image contrast is obtained by the interaction of the electron beam with the sample: a part of the electrons will be diffracted. By means of an aperture, one or more diffracted beams are selected for the formation of the image. In this way, one can distinguish between different materials as well as image individual crystals and crystal defects.
The measurements have been carried out using the JEOL-TEM JEM-2000 EX/T. Diffraction patterns have been taken using a high energy electron beam of about 200 kV.

- XPS

XPS is one of the most important methods for detecting the chemical composition and the binding properties as well as the electronic structure. The principle of XPS is based on the interaction between an electromagnetic wave and a material (atoms). Since the XPS spectrum reflects the electronic structure of a material

directly, it provides information on electron configurations and energy levels within atoms. Additional it is possible to make depth scans. Therefore the sample is etched by an electron beam.
XPS measurements have been carried out using the JEOL-XPS JPS-9010 MC/IV. The Mg Kα line (1254 eV) has been used. The etching was carried out by an Argon beam.

• FT/IR
Because chemical bonds absorb infrared energy at specific frequencies (or wavelengths), the basic structure of compounds can be determined by the spectral locations of their IR absorbtions. The plot of a compound's IR transmission vs. frequency is its "fingerprint", which when compared to reference spectra identifies the material.
For the measurements a FT/IR-680 JAS.CO has been used.

3. Results & Discussion

Unfortunately the FT/IR analyses gave no useful results, caused by problems at the sample preparation. New measurements are still in progress.

The XRD patterns show that both compounds possess really complicate crystal structure. There were no reference patterns in XRD data bases. Caused by the difficult structure it was not possible until now to determine the lattice parameters. So the coefficient of expansion could not be calculated.

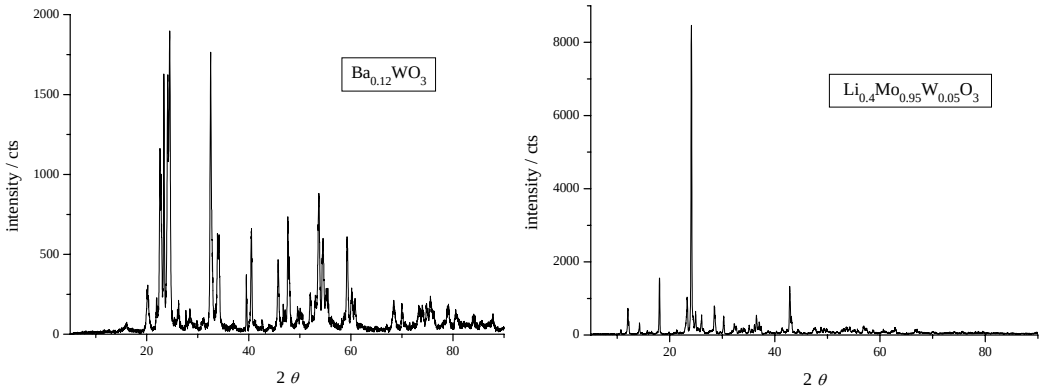

Fig. 1: XRD powder pattern of $Ba_{0.12}WO_3$ and $Li_{0.4}Mo_{0.95}W_{0.05}O_3$ at room

High temperature experiments show no phase transition. In the case of $Ba_{0.12}WO_3$ no changes of the lattice parameters could be observed. In the case of $Li_{0.4}Mo_{0.95}W_{0.05}O_3$ a small shift caused by temperature expansion of the lattice. This process is reversible. Measurements at higher temperatures were not possible, because of the low decomposition temperature in air.

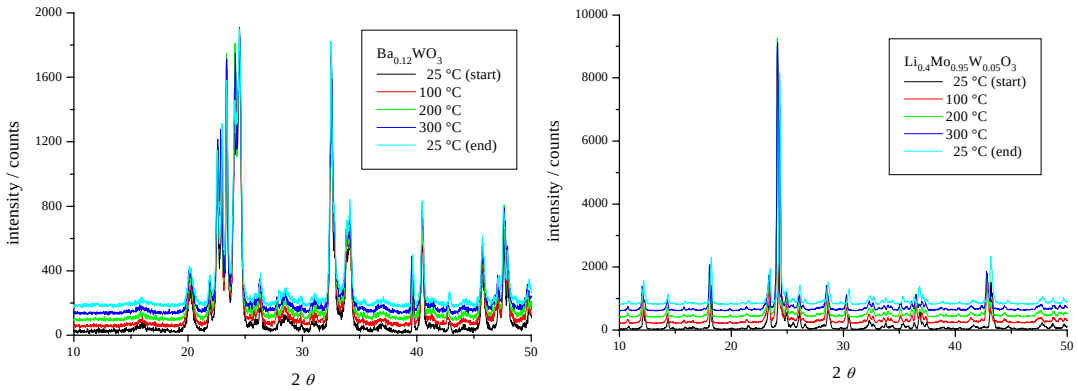

Fig. 2: XRD powder pattern depending on changing temperature

XPS and TEM measurements suggest a layered structure of this compounds.

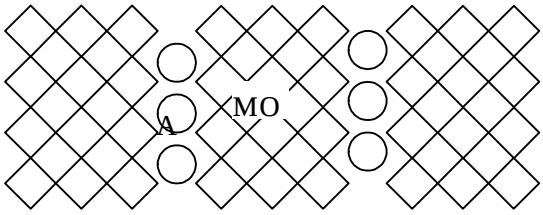

Fig. 3: Strong simplified scheme of the layer structure

M = Mo or W in different valence states

A = Li or Ba

In the case of $Li_{0.4}Mo_{0.95}W_{0.05}O_3$ the TEM diffraction pattern are complicate. More measurements are necessary for getting more information about lattice parameters. For $Ba_{0.12}WO_3$ the lattice parameters could be estimated (as a first approximation) with the following values: a = 6.8, b = 4.0 and c = 13.0. A tetragonal lattice is expected. Now further investigations like Rietveld refinement are necessary.

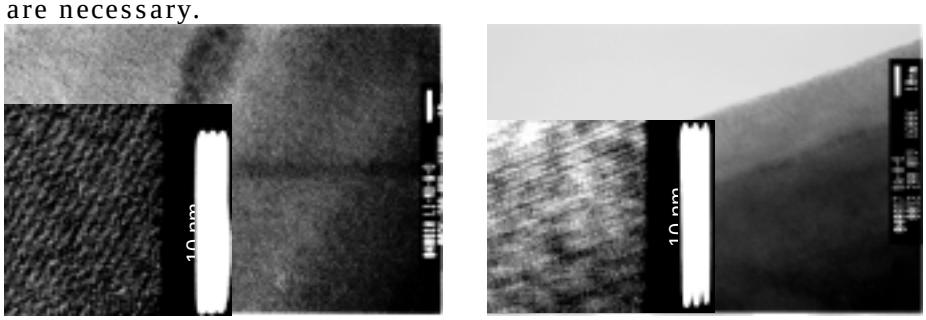

Fig. 4: High resolution TEM images

The XPS measurements at the samples before etching gives quite different results caused by absorption and aging effects on the surface. The dept scans show that all components are homogenous distributed in the sample. Li could not be detected with Mg Kα radiation. Further measurements with other X-ray sources are in progress. It could be observed that the Mo and W peaks show a shift and changing intensities while etching. That means that the transition metals change the valence states. At the moment it is not clear if the effects are caused by the layer structure or by decomposition effects on surface. Therefore also additional measurements with longer etching times are in progress.

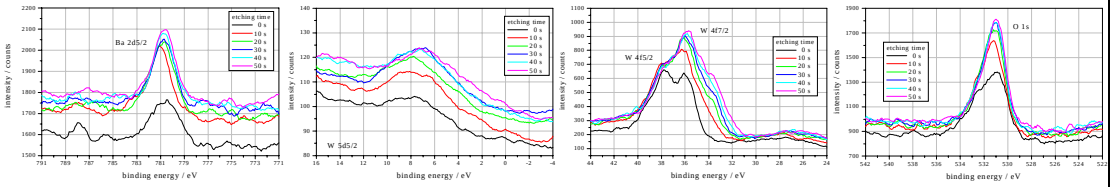

Fig. 5: XPS measurements on $Ba_{0.12}WO_3$

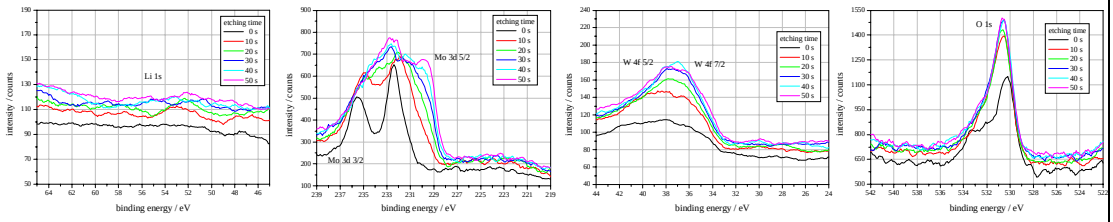

Fig. 6: XPS measurements on $Li_{0.4}Mo_{0.95}W_{0.05}O_3$

8. Please add your comments (if any):

Special thanks go to Izumi Watanabe from the Yamaki-Lab of Kyushu University. She taught me how to use XPS and FT/IR and helped me to make a lot of interesting measurements. We had a great deal of discussions.

RESEARCH REPORT

1. Name: Katrin Gehring (ID No.: SP 04303)

2. Current affiliation: PhD Student: University of Magdeburg, University of Zurich, Swiss Federal Research Institute WSL, Zurich

3. Research fields and specialties:

☐ Humanities ☐ Social sciences ☐ Mathematical and Physical Sciences

☐ Chemistry ☐ Engineering Sciences ☐ Biological Sciences

☐ Agricultural Sciences ☐ Medical, Dental and Pharmaceutical Sciences

☐ Interdisciplinary and Frontier Sciences

4. Host institution: Tamagawa University, Tokyo, Faculty of Education

5. Host researcher: Prof. Dr. Makoto Kobayashi

6. Description of your current research:

I currently do research for my PhD thesis in the field of environmental and social psychology. Working title of the PhD thesis is: “Demands on landscape: Connections with landscape preferences and their role for leisure mobility.”

In a first part this project investigates how landscape preferences are related to different demands on landscape such as the whish to experience security, arousal or autonomy when spending time in landscape, ecological or economical interests as well as socio demographic aspects (e.g. place of residence). In a second part landscape related factors of leisure mobility are investigated. It is asked in which way leisure mobility is explained by landscape related needs and demands which cannot be fulfilled in the landscape near home and therefore motivate compensatory leisure mobility towards other landscapes, e.g. alpine landscape.

A representative survey has been conducted in Switzerland by means of a standardized questionnaire, which included among other things photorealistic simulations of various landscape scenarios, to be assessed by the participants of the study. More than 1000 German-speaking andFrancophone Swiss as well as about 500 tourists in two alpine valleys have been surveyed.

7. Research implementation and results under the program

Title of your research plan:

Values and Attitudes in Cross-Cultural Comparison. In Which Way are Landscape Related Attitudes of the Swiss and Japanese People Influenced by Individual and Cultural Value Priorities?

Description of the research activities:

Goal of this project is to study similarities and differences in landscape related attitudes between different cultural groups and to examine how these attitudes are connected with more general value orientations. According to literature on values and attitudes, values are assumed to work as an organized and hierarchical system, which determines attitudes and behavior (e.g. Olson & Zanna, 1993). Attitudes investigated in this study represent for example aspects of place identity (Twigger-Ross & Uzzell, 1996), feeling of threat through nature (Asquith & Kalland, 1997) or the importance of nature and landscape for everyday life.

The study compares people living in Japan and Switzerland. As it is widely assumed, that both nations have a special relationship to (their) landscape and nature (e.g. Bruun & Kalland, 1995; Stremlow, 1998) whereas both countries differ much in aspects of their socio-cultural tradition and orientation.

Besides learning more about the methods of cross-cultural research most important goals of the research stay in Japan were first to discuss the concepts of attitudes towards nature and landscape which this project focuses on and then to translate the German version of the questionnaire into Japanese.

During the process of discussing these issues with researchers from the field of environmental and landscape studies (Forestry and Forest Research Institute, Kyoto; Graduate School of Systems and Information Engineering, University of Tsukuba; National Institute for Environmental Studies, Tsukuba) and psychology (Department of Education, Tamagawa University; Graduate School of Environmental Studies, Nagoya University) it emerged, that the general concept of landscape as it is used in German and therefore in the German version of the questionnaire does not exist correspondingly in the Japanese language. Landscape can be translated in different ways (e.g. “Fukei”, "Keshiki", “Keikan”), every translation representing a different concept of landscape. A general image of landscape as it exists for “nature” or “environment” seems not to exist . This means that new research questions emerged that first have to be answered before going on with the translation of the questionnaire: 1. Which concepts and images of landscape are represented by the

different words for landscape in the Japanese language and which meanings do they have for Japanese people? 2. Do the Japanese really lack a general concept of landscape as they cannot express it in their mother tongue?

To answer these questions semi-standardized interviews have been conducted with experts on landscape as well as persons who do not have a professional connection to environmental themes.

A first analysis of the interviews shows that people can clearly distinguish between different types of landscape associated with the different words for landscape in Japanese. These landscape-types differ in the elements which constitute this landscape (e.g. just natural and rural elements versus more human made and also urban landscape elements) as well as in the relationship between the person (the self) and the landscape (e.g. interaction with a landscape versus a distant view on the landscape; attachment to and personal memories connected with the landscape).

After finishing the analysis of the interviews the concept of the project will be adapted and one type of landscape represented by one of the possible Japanese words for landscape will be chosen to focus on. This is being a prerequisite to obtain equivalent versions of the questionnaire in both languages. After finishing the translation, data collection will be conducted in Zurich (Switzerland) and Tokyo, Kyoto and Nagoya (Japan). 200 students in each country will be surveyed. Researchers at respective universities already endorsed this.

Asquith, P. & Kalland, A. (eds) (1997). *Japanese Images of Nature. Cultural Perspectives*. London: Curzon Press.

Bruun O. and A. Kalland A.(eds) (1995). *Asian Perceptions of Nature: A Critical Approach*. London: Curzon Press.

Olson, J. M. & Zanna M. P. (1993). Attitudes and attitude change. *Annual Review of Psychology*, 44, 117-154.

Stremlow, M. (1998). *Die Alpen aus der Untersicht. Von der Verheissung der nahen Fremde zur Sportarena: Kontinuitaet und Wandel von Alpenbildern seit 1700*. Bern: Haupt.

Twigger-Ross, C. L. & Uzzell, D. L. (1996). Place and identity processes. *Journal of Environmental Psychology*, 16, 205-220.

RESEARCH REPORT

1. Name: Sandro Leuchter (ID No.: SP04304)

2. Current affiliation: MoDyS Research Group
Center of Human-Machine-Systems, Technische Universität Berlin, Germany

3. Research fields and specialties:

☐ Humanities ☐ Social sciences ☐ Mathematical and Physical Sciences
☐ Chemistry ☒ Engineering Sciences ☐ Biological Sciences
☐ Agricultural Sciences ☐ Medical, Dental and Pharmaceutical Sciences
☒ Interdisciplinary and Frontier Sciences

4. Host institution: Cognitive Systems Engineering Laboratory
Department of Quantum Engineering and Systems Science, The University of Tokyo

5. Host researcher:
Prof. Kazuo Furuta, Dr. Eng.

6. Description of your current research

Research in human-machine systems is concerned with the operation safety of technical systems. The main perspective is on human error which can be caused by the so called human factor or the organizational environment. The human factor – i.e. characteristics of human perception, information processing, timing capabilities and decision strategies – has to be taken into account in the development of human-machine systems. With this requirement in mind human-machine systems research is carried out to guide the design, analysis and evaluation of the human-machine interface and the degree of automation.

The application of human performance models is currently a new approach for answering human factors related questions. Human performance models are computer simulations of aspects of the human characteristics that influence the operation of technical systems. In my research I am deploying methods coming from cognitive psychology and artificial intelligence to provide new tools for applied human performance modeling. I am using the cognitive architecture ACT-R/PM as the basis of computational simulation models. Although it already provides some useful constraints and human characteristics the complexity and dynamics of human-machine systems require some extensions. Case studies in en-route air traffic control and process control in chemical plants have guided the development of a new perception and software engineering oriented extension ("agimap") and the conceptualization of a timing component ("timer") for ACT-R/PM.

7. Research implementation and results under the program (As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Human performance modeling applied in the nuclear power plant domain

Description of the research activities:

I conducted a case study on the application of ACT-R/PM for human performance modeling. The focus was on the further development and deployment of the proposed extensions of the cognitive architecture ACT-R/PM for human performance modeling in human-machine systems engineering. After a review of research at the Cognitive Systems Engineering Lab we have chosen DURESS for the case study. DURESS is a microworld for studying human factors effects of interface design and automation. It is a synthetic task in a thermal-hydraulic process simulation environment and designed to be representative of complex human-machine systems. Prof. Furuta and Dr. Kanno used DURESS for investigating team interaction and created an inference engine for predicting task allocation within the team. The Java based DURESS microworld needed to be extended for my project. I developed a portable TCP/IP communication interface and adopted the Java Beans property pattern for the simulator. This made it feasible to connect simulator and communication layer according to the publisher/subscriber design pattern. It is now possible to connect multiple models or other clients to the DURESS microworld.

The ACT-R/PM human performance model is based on an existing plan library which had been developed by a means-end task analysis. To incorporate the plans I have chosen a formalism suited for later generalization in other models (GOMS). To use it I developed a new ACT-R/PM layer for using such knowledge structures in a cognitively plausible way and transformed the library into a GOMS representation. Additionally I implemented the timer extension for ACT-R/PM. It allows human performance models to perceive the elapsed time compared to reference points in the past. This extension takes the simulated cognitive workload into account so it can come to erroneous duration estimations. It is also possible that reference points are confused or forgotten. I used the already existing agimap extension for perception and connected the human performance model and DURESS. This proved to be comparatively easy. Additional knowledge about team interaction made it possible to simulate team operation of DURESS. An evaluation of the resulting model is still to be done. It turned out that the existing data on DURESS operation is not suited for

an evaluation of this model. It is planned to conduct comparative experiments with different DURESS interface variants in Berlin to test the agimap extension.

As the theoretical part of my research I merged ideas of home and host research group and proposed a framework for adaptive automation in human-machine systems based on parallel operating human performance models. The internal state of the human performance simulations is taken to deduce operator workload which is in turn used to decide the appropriate level of automation to minimize human error. Some concepts of this framework had already been applied in a simulation based training system for air traffic control.

I had the opportunity to present the methodology of human performance modeling based on ACT-R/PM and our new extensions to the Research Committee on Human-Machine Systems of the Atomic Energy Society of Japan and the proposed framework for adaptive automation in human-machine systems to the Cognitive Systems Engineering Group at their regular lab meeting.

I could also visit and exchange ideas with human factors oriented research groups at the Central Research Institute of Electric Power Industry, the Research Institute for Electronic Navigation (air traffic control), the National Maritime Research Institute (ship navigation), and the Research Institute of Science and Technology for Society (nuclear power plant operation).

8. Please add your comments (if any):

The JSPS summer program was a very useful research experience for me. The case study will be a part of my doctoral dissertation and I would like to continue cooperation with research groups that I became acquainted with.

9. (If any) Advisor's remarks:

Mr. Sandro Leuchter made a very good work during his stay at the University of Tokyo. In addition, students of our laboratory and Japanese researchers on process human-machine systems enjoyed valuable discussions and exchange of knowledge with him. Though the stay period was not long, it seems his stay was worthwhile for us as well as his thesis study.

RESEARCH REPORT

1. Name: Silke Peters (ID No.: SP04305)

2. Current affiliation: Institute of Physics, University of Greifswald, Germany

3. Research fields and specialties:

☐ Humanities ☐ Social sciences X Mathematical and Physical Sciences

☐ Chemistry ☐ Engineering Sciences ☐ Biological Sciences

☐ Agricultural Sciences ☐ Medical, Dental and Pharmaceutical Sciences

☐ Interdisciplinary and Frontier Sciences

4. Host institution: Research Institute for Applied Mechanics, Kyushu University, Kasuga, Kasuga Koen 6-1, 8168580

5. Host researcher: Prof. Dr. Kohnosuke Sato, Prof. Dr. Kiichiro Uchino, and Prof. Dr. Sanae-I. Itoh

6. Description of your current research

Several industrial applications employ oxygen plasmas in surface treatment. Here the atomic oxygen is an important reaction partner in volume kinetics and responsible for many plasma-based surface processes, like oxidation or etching of polymer films. As a good approach to enhanced knowledge of plasma-surface interaction in a low-temperature oxygen plasmas, studies of spatial-temporal O-density distributions were performed by two-photon laser induced fluorescence spectroscopy (LIF). As a main result a comprehensive similarity parameter was empirically found, describing the shape of the spatial O-atom density over a wide range of plasma parameters. This parameter is based on the O-atom production in the plasma bulk, diffusion transport and loss at the walls.

7. Research implementation and results under the program (As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan: Studies of Laser-Thomson Scattering measurements in PDP Micro-discharges

S.Peters, S. Hassaballa, K. Uchino, J. Meichsner, K. Sato, and S.-I. Itoh

Description of the research activities:

Natural plasmas like interstellar clouds and fire are common to everybody. All of them have one thing in common: the matter is (partially) ionized. Besides, many man-made plasma devices like neon lights and plasma displays are familiar to non-physicists Plasma display panels (PDP's) are self-emissive flat displays that widely introduced into the market in the past few years. A PDP is essentially a matrix of submillimetre fluorescent lamps controlled by complex electronic drivers. Each pixel of a PDP is composed of three elementary discharges, emitting UV light, which is converted by phosphors in the three primary colours of visible light. In every cell the plasma is generated by a dielectric barrier discharge (DBD) [1].

Although the PDP has been introduced into the market, there is still a large margin of improvement in luminous efficiency, mainly due to the low production rate of excited Xenon atoms in the discharge. Electrons in plasmas play an important role in excitation processes. By obtaining energy from the applied electric field of the discharge, the electrons induced inelastic collisions with neutrals, which determines the PDP efficiency. Therefore, in order to optimize the external discharge conditions and parameters, an advanced knowledge of the spatio-temporal distribution of electron density and temperature is highly recommended [2].

Laser-Thomson scattering (LTS) is a nonintrusive method to study electron properties in plasma devices. In the coherent regime, the scattered spectrum reflects the electron motion by Doppler broadening, that means the electron temperature T_e, and the scattered intensity is proportional to the electron density n_e [3].

Due to the small extension of micro-discharge plasmas (about 0.2 mm) the scattering volume becomes less, which results in very small Thomson scattering intensities. Normally PDP`s operates at high pressures. In this case neutral and ion density is high and a strong signal generated by Rayleigh scattering at the bounded electrons appears. Additional it is not possible to avoid scattering of the incoming laser light at the electrode surface and the walls of the discharge chamber. An important factor in LTS measurements is the reduction of stray laser light and Rayleigh scattering signal centered at the laser wavelength In order to overcome these difficulties, the method of photon counting, and a special triple-grating spectrometer (TGS) having a stray light rejection of 10^8, have been used. To suppress the Rayleigh spectrum the signal was blocked inside the TGS after the first grating.

A well known universal phenomenon in ac PDP discharges are striations, which have been observed experimentally for several electrode configurations and discharge environments [4]. They appear only at the anode side of the PDP discharge. Kinetic simulation of real discharge cell reproduced well defined plasma density humps near the anode side. The formation of these density humps were attributed to the creation of multiple-layer potential distribution near to the anode region due to the wall charges, accumulated on the dielectric layer covering the anode surface [5]. Although simulations showed comparable striations above the anode region, the formation mechanism has not been fully understood up to now [1]. Especially, experimental investigations of the spatio-temporal distribution of the plasma parameters n_e and T_e have not been reported yet. In this report first results are presented of qualitative electron density behavior along the anode side of the PDP like micro-discharge.

Experimental setup

The experimental setup is shown in Fig. 1, and was similar to [2]. A Ne-Ar (5-10%) gas mixture was used pressure range of 100-200 Torr. Alternating voltage pulses with a square waveform were applied between the electrodes at a frequency of 20 kHz with a duty ratio of 1. The peak value of the applied pulse voltage was 220V-240 V.

Since the electrode structure of the real PDP cell is not suitable for performing LTS measurements, an electrode structure, more suitable for the experiments, was designed. Sustain electrodes are built up on a glass substrate, covered by a transparent dielectric layer; the thickness of the dielectric layer is about 0.02 mm. The dielectric surface is coated by a protective layer, which has a high secondary elctron emission coefficient. The electrode had a length of 50 mm and a width of 1mm, which allows to approach the laser beam up to 0.06 mm to the electrode surface. Wider electrodes may result in touching the substrate edges by the laser beam. This would damage the electrode material and induce an intensive of stray light signal.

The laser light at a wavelength of 532 nm, was produced by frequency doubling of the fundamental of a Nd:YAG laser (repetition rate of 10 Hz, and a pulse width of 6 ns). The laser was triggered externally to synchronize the laser timing with the temporal evolution of the discharge. The focused beam had a diameter of about 0.05 mm and could be approached to a minimum height of Z = 0.06 mm above the surface of electrode-substrate.

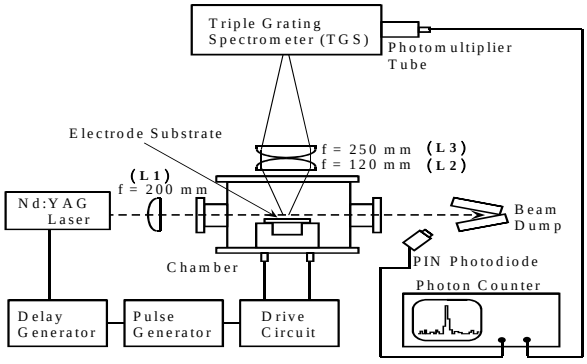

Fig.1. Experimental setup of the LTS measurements in a PDP micro-discharge.

The scattered light was observed perpendicular to the laser beam at a magnification of two. The collected light passed through the TGS and was detected by a photomultiplier. To follow the spatio-temporal behavior of the striations measurements were performed in a range of 0.5 mm along the anode under different experimental conditions.

Results

A typical Thomson scattering spectrum is shown in Figure 2a. In Figure 2b Thomson scattering intensities are plotted in the ordinate in logarithmic scale against $(\Delta\lambda)^2$, the square of the differential wavelength from the laser wavelength, the latter being proportional to the electron energy. From the straight line of the Thomson spectrum,

the electron energy distribution function (EEDF) was concluded to be Maxwellian. The electron temperature could be determined to 1.6 eV and the electron density was found to 2.3 10^{-19} m^{-3}, which was in good agreement with previous investigations [2]. A suitable working point for measurements was found at a height of 150 µm in front of the electrode and at 300 ns after increasing discharge voltage.

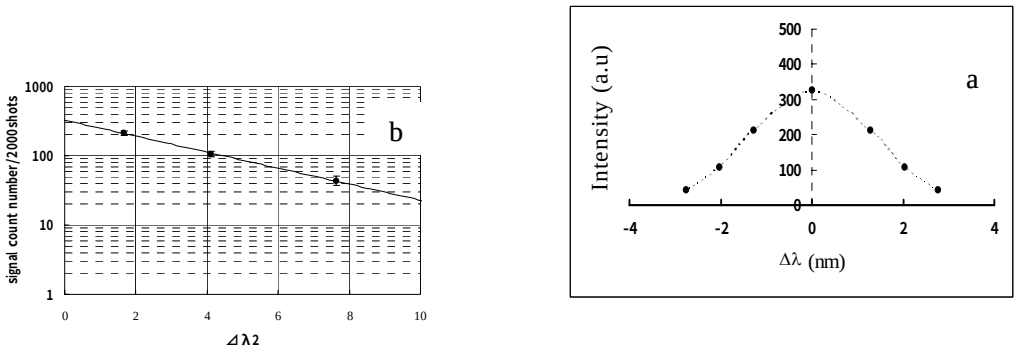

Fig.2 a: Experimental and b: fitted Thomson spectrum.

To study qualitatively the horizontal behavior of the striations only one point of the Thomson spectrum was taken into account. Figure 3 compare the spatial distribution of the LTS measurements with results of 2-dimensional optical emission spectroscopy at a pressure of 100 Torr, NeAr(5,2%). Both graphs show clearly discriminable maxima.

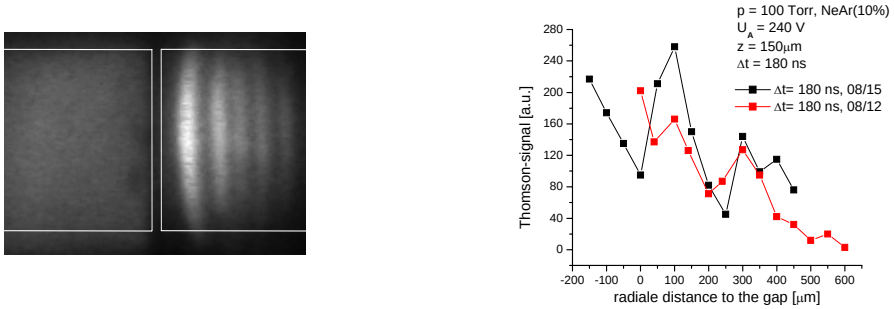

Fig. 3 Qualitative behavior of the striations observed along the anode side

Further investigations have to be done to determine quantitative results of the electron density and temperature, for different gas pressures and admixtures. This will lead to a better understanding of the mechanisms forming these structures.

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[5] C. H Shon and J. K Lee, Phys. of Plasmas **8** (2001) 1070.

RESEARCH REPORT

1. Name: Birgit Pils (IDNo.SP04306)

2. Current affiliation:

Department of Bioinformatics, Wuerzburg University, Germany

3. Research fields and specialties:

☐ Humanities ☐ Social sciences ☐ Mathematical and Physical Sciences

☐ Chemistry ☐ Engineering Sciences X☐ Biological Sciences

☐ Agricultural Sciences ☐ Medical, Dental and Pharmaceutical Sciences

☐ Interdisciplinary and Frontier Sciences

4. Host institution:

Bioinformatics Center, Institute for Chemical Research, Kyoto University

5. Host researcher: Prof. Hiroyuki Toh

6. Description of your current research

The focus of my PhD studies is the analysis and prediction of protein function from sequence and structural information. Central to my work is the organization of proteins into domains, which are conserved in sequence and structure and represent the smallest functional unit of a protein. In the past, I have been working on the effect of evolution on protein function and I tried to link my approaches to study the behavior of amino acids sites involved in protein-protein interactions with the goal of predicting interaction sites. Together with Professor Toh I studied a different facet of protein-protein interactions that is able to predict interacting partners in contrast to amino acid positions involved in the interaction. This approach is closely related to my previous work in Germany, since it is based on conserved sequence signatures. These signatures can resemble protein domains, but also describe smaller conserved elements in proteins. It has been shown before, that sequence signatures can be used to predict intracellular interactions. Our project aimed for modifying this method to predict extracellular domains interacting between species.

7. Research implementation and results under the program (As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Prediction of interactions between extracellular protein domains using correlated sequence signatures

Description of the research activities:

Protein-protein interactions between extracellular domains of transmembrane proteins as found in the immune system play a pivotal role and can determine the fate of an organism. Exemplified by the Anopheles mosquito and the Plasmodium parasite, we identified putative interaction partners between the two species. Our method is based on correlated sequence signatures in experimental interaction data. This means, that we scanned proteins that are known to interact for conserved sequence signatures and searched for signature pairs that were more often found than expected at random. These signature pairs are termed correlated sequence signatures. By restricting our analysis on transmembrane proteins we hoped to largely eliminate interactions between cytoplasmic domains. Further studies are necessary to confirm this and to analyze interacting partners of the Anopheles and Plasmodium proteome, so I hope to stay in touch with my Japanese host to continue this project.

8. Please add your comments (if any):

My stay in Professor Toh's group has been very stimulating for me and broadened my view on bioinformatics. Professor Toh introduced me to many Japanese scientists and I had a lot of interesting discussions at the institute and also at an international symposium in Osaka. Besides work, it has been a great cultural experience and I gained a little insight into daily life in Japan. I am very thankful that I had the chance to visit Kyoto University through the JSPS program. My visit in Japan has been a wonderful experience – scientifically and personally - and I will remember this summer as one of the most exciting ones of my life.

RESEARCH REPORT

1. Name: Ms. Pufahl, Andrea (ID No.: SP04307)

2. Current affiliation: Scientist at the Federal Agricultural Research Centre (Germany), Institute for Rural studies

3. Research fields and specialties:

☐ Humanities ☐ Social sciences ☐ Mathematical and Physical Sciences
☐ Chemistry ☐ Engineering Sciences ☐ Biological Sciences
☐ **Agricultural Sciences** ☐ Medical, Dental and Pharmaceutical Sciences
☐ Interdisciplinary and Frontier Sciences

4. Host institution: Policy Research Institute (PRIMAFF), Ministry of Agriculture, Forestry and Fisheries (MAFF), 2-1 Nishigahara, 2-chome, Kita-Ku, Tokyo, Japan

5. Host researcher: Ms. Tomoko Ichida Ph. D.

6. Description of your current research

At my home research institution I am engaged in the evaluation of rural development policies in six federal states in Germany. Our task is to evaluate and, possibly, to quantify the effects of European rural development policies in respect to the following issues: income, maintenance of rural areas/rural population, environment, administrative implementation and employment.

The subject of my doctoral thesis builds upon the results, to be gathered through the above mentioned project. The objective of my doctoral thesis is to classify rural development measures according to their innovative/progressive or conservative character as regards their ability to promote structural adjustment and modernization of rural areas.

7. Research implementation and results under the program:

Title of your research plan: Rural development policy in Japan

Research results: During my stay at the Policy Research Institute in Tokyo (PRIMAFF) I prepared a draft, respectively collected data and information, for a paper about rural development policies in Japan. The paper is organized as follows:

1 Introduction
2 Current trends in rural Japan
3 Driving forces for rural change
4 Rural Development Policy in Japan
5 Approaches and perspectives to rural development policy in Japan
6 Conclusion

The paper will be completed at my home institution and send for reviewing to Japanese officials and scientists, who kindly provided me with information about this issue.

Research activities: Information and data about rural development policies in Japan were gathered on the basis of various activities:

1 Consulting with and translation through Dr. T. Ichida (PRIMAFF, host researcher)
2 Desk research via internet and English publication
3 Interviews with government officials and scientists of various institutions in Japan:
Mr. S. Ikezoe and Mr. H. Tsuzuki (Management officer of Agriculture in Otoyo town, Kochi)
Mr. Y. Saika (MAFF, Director of the Rural Policy Coordination Office)
Mr. H. Shimada (MAFF, Investment aid for farmers)
Mr. I. Miyao (MAFF, HMA direct payment)
4 Interviews and consultation with scientists
Dr. Y. Iiguni (Kochi University)
Prof. Y. Morooka, (Kochi University)
Mr. O. Chiba (PRIMAFF)
Mr. A. Egawa (PRIMAFF)
Mr. Y. Watanabe (PRIMAFF)
Prof. H. Yokogawa (Kyushu University)
Dr. Y. Matsuda (Tokyo University, Dep. of Agriculture & Resources Economics)
Dr. T. Odagiri (Tokyo University, Dep. of Agriculture & Resources Economics)

4 Interviews and consultation with farmers and staff of agricultural cooperatives in Otoyo town (Kochi) and Kurume (Kyushu)

5 Participation in the RIETI Symposium "Agricultural and policy reform in the 21st Century" at the 28.07.2004 in Tokyo

6 Presentations about European rural development policies at PRIMAFF (Tokyo) and Kyushu University.

8. Please add your comments (if any):

I great full thank my host researcher Ms. T. Ichida from PRIMAFF, who was any time prepared to answer my question, arrange appointments and provide Japanese to English or German translation.

Equally I thank all collaborators of PRIMAFF for the friendly reception at the institute and all people who provided me with information and useful remarks.

9. (If any) Advisor's remarks:

Ms. Andrea Pufahl is very actively engaged in her research for comparing rural development policy between EU countries and Japan. It is partly because she stays in Japan for the first time, that her questions and point of views seem sometimes very fresh and even stimulating for us. By discussing with her we get a good opportunity to rethink Japanese agricultural and rural policy. I personally wish there were more colleagues accustomed to communicating with foreign researchers like her in English.

Tomoko Ichida, PRIMAFF

RESEARCH REPORT

1. Name: Dr. Marcus Rohnke (ID No.: SP04308)

2. Current affiliation:

Institute of Physical Chemistry, Justus-Liebig University of Gießen

Heinrich-Buff-Ring 58, 35394 Gießen, Germany

3. Research fields and specialties:

☐ Humanities ☐ Social sciences ☐ Mathematical and Physical Sciences

☒ Chemistry ☐ Engineering Sciences ☐ Biological Sciences

☐ Agricultural Sciences ☐ Medical, Dental and Pharmaceutical Sciences

☐ Interdisciplinary and Frontier Sciences

4. Host institution:

Institute of Multidisciplinary Research for Advanced Materials

Tohoku University, 2-1-1 Katahira, Aoba-ku, Sendai 980-577

5. Host researcher: Prof. Dr. Tatsuya Kawada

6. Description of your current research

Plasmas are ionized gases with a high energy. They are often called the fourth state of matter. We can observe them in nature, i.e. flashes occurring during thunderstorms. Man-made plasmas are burning inside of neon lamps. In chemical and also physical industrial processes plasmas are more and more often used for running processes more environmentally conscious. We can make so-called ‘green chemistry’ using plasmas.

In my current research I am interested in the interaction of low temperature plasmas with ceramic materials that show ionic conductivity. Materials with this property are well known. For example they are used in high temperature solid oxide fuel cells or oxygen sensors (lambda probes). In our research work the interface between yttria-stabilised zirconia (YSZ) and oxygen plasma is of special interest. The most important aspects are the interfacial kinetics and the stability of the solid materials that are immersed into the plasma.

Starting from these investigations we are interested, if it is possible to manipulate the plasma by using these ceramic materials. Particularly, it would be fine to pump negative oxygen ions electrochemically through a material showing oxygen ion conductivity into an oxygen plasma. For a variety of processes it is important to have oxygen plasmas with a high concentration of negative ions.

7. Research implementation and results under the program (As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Oxygen ion emission from a bare yttria-stabilised zirconia surface

Description of the research activities:

In the japanese host laboratory an experimental ion emission setup already exists. Prior to my arrival the heater of this setup was changed for decreasing the noise of the measurement signal. During the research stay in Japan we repeated two measurement series for the oxygen ion emission from a bare YSZ-surface. The aim was to make sure that the results are in principal the same as before.

The emission setup (see fig. 1) consists of a glass tube with a quadrupol mass spectrometer on top. The tube can be heated up to 950 °C using an electrical furnace and be evacuated to a pressure of 10^{-3} Pa. Inside of the glass tube a semi-closed ceramic tube (yttria-stabilised zirconia) is fixed. These ceramic material shows oxygen ion conductivity at temperatures above 350 °C. There is an extraction electrode in front of the closed end of this tube. For the first experimental series we used a platinum mesh type electrode and for the second series a platinum pinhole electrode is used. Inside of the tube is a platinum electrode (porouse platinum paste). During the emission measurement an extraction voltage of 300 V is applied between the outer (extraction) and the inner electrode. The mass spectrometer is detecting the negative oxygen ions and electrons that are emitted from the YSZ-surface.

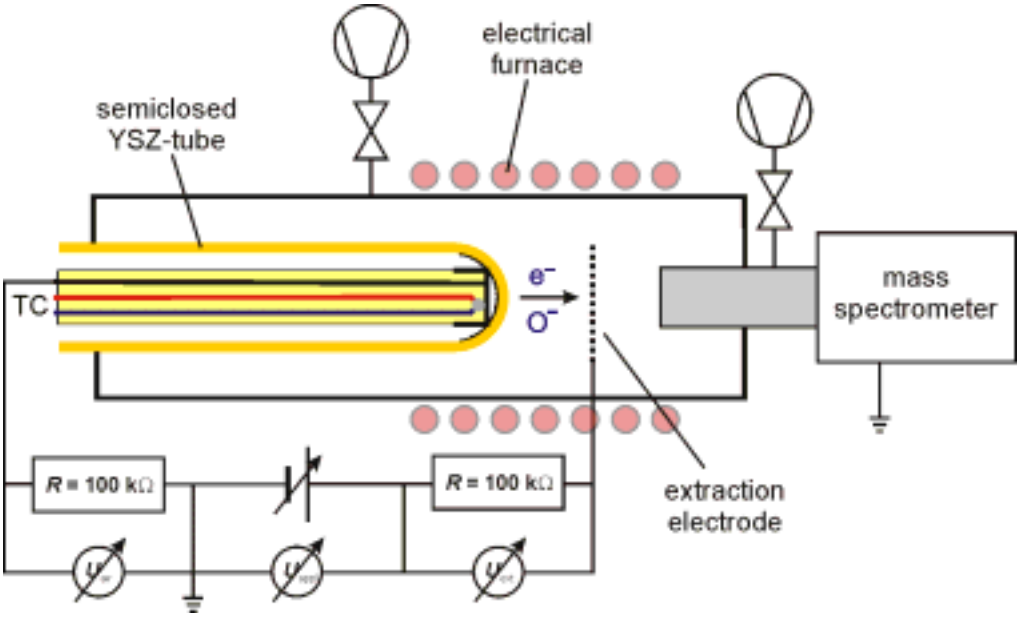

Figure 1: Sketch of the experimental setup for the ion-emission experiments.

Using the mesh type extraction electrode the emission current is very low. In principal the same effects as before can be observed: a) the emission current decreases with time until it reaches a low stable value, b) after switching off the emission voltage for a certain time (interval time) the emission current increases again and shows the same behaviour as described in a). Both, the mass spectrometer signal and the electrometers signals are too low for analysing the emission kinetics. The inital O^- count rate shows approximately a linear dependency to the interval time.

If using the pinhole electrode, the results are qualitatively the same. Exceptionally, the emission current is definitely higher. Thus, it was possible to measure the time dependency of the ion emission flux (mass spectrometer signal). The emission flux decreases after switching on the extraction voltage. The decrease can be described with an exponential decay of second order. The same can be done with the emission current measured by using the electrometer. By integrating this curve the number of charge carriers can be calculated. As a first approximation it is in the same magnitude as the number of oxygen atoms of one atomic surface layer.

8. Please add your comments (if any):

Despite of the fact that the time of the research stay in Japan was very short, I got an insight in the japanese way of doing research work. In addition, the japanese culture and especially kindness were very impressive. Definitely, the time was too short for producing real results in a physical chemistry experiment. However the new experimental experiences and the personal contacts should be positive for my future research work.

RESEARCH REPORT

1. Name: Andreas M. Schöpp
(ID No.: SP04309)

2. Current affiliation: TU Berlin
Fak. II - Institut für Mathematik - MA 8-1
Straße des 17. Juni 136
10623 Berlin
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3. Research fields and specialties:
□ Humanities □ Social sciences □ **Mathematical and Physical Sciences**
□ Chemistry □ Engineering Sciences □ Biological Sciences
□ Agricultural Sciences □ Medical, Dental and Pharmaceutical Sciences
□ Interdisciplinary and Frontier Sciences

4. Host institution: Tokyo Metropolitan University (TMU)
Department of Mathematics
Minami Osawa 1-1, Hachioji-shi
Tokyo, 192-0397, Japan

5. Host researcher: Prof. Dr. Ken Nakamula

6. Description of your current research

In my article "Familles de polynômes aux courbes modulaires $X_1(l)$ unicursales et points rationnels non-triviaux de courbes elliptiques quotient" I describe the construction of number fields whose Galois group is isomorphic to the diedral group D_n ($2<n<11$ or $n=12$). I based this construction on the torsion group of an elliptic curve over the rationals. A number field K of degree n can be constructed with the help of a point of order n ($2<n<11$ or $n=12$). This method depends on one parameter (in the case $n=3$ on two parameters) such that the result is a family of number fields with Galois group D_n.

This result raises the question whether such a construction is also possible for cyclic field extensions. Indeed I was also able to give a parametrized construction for the degrees n under consideration for this case.

After this construction it is natural to ask for the computation of parametric invariants of such number fields. The computation of and in a fixed number field with small degree is an easy challenge thanks to computer algebra software like the package Kant/Kash which is developed in Berlin. Problems arise from the parametric form of the number fields and therefore by the study of a class of number fields at once. The computation of the Galois group as one invariant is nowadays possible with number theory software (if the degree is not to high). But a parametric computation of the unit group of a family of number fields is not realizable.

Today only a few parametric unit groups are known: With increasing unit rank (and associated number field degree) the computation becomes difficult very quickly. There are articles published considering degree 4 and rank 2 and 3, degree 5 and rank 4 (one family), degree 6 and rank 3 and degree 8 with rank 7; here most authors work with biquadratic (and in the degree 8 case with triquadratic) number fields and obtain thereby with an adept construction of the fields a set of fundamental units. Apart from the octic case only one family of number fields with unit rank greater 3 has been published.

7. Research implementation and results under the program (As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:
Unit computation in parametric families of number fields

Description of the research activities:
I studied two families of number fields of degree 5 in a parametric form with unit rank 2 and 4 and I computed invariants (unit group and Galois group). On one part I turned the attention to number fields with a maximal set of independent units which is by a Theorem of dirichlet exactly the degree of the number field minus 1. The method for the rank 4 family (Galois group S_5) was not " a bottom-up method" by clever merging small number fields as in the biquadratic and triquadratic examples. It was " a top-down method" by considering first units and then finding number fields containing them. On the other part I studied the unit group of rank 2 of the degree 5 family with Galois group D_5 of my previously mentioned article " Familles de polynômes… ". Since it was not possible to compute better estimates for the regulator than the already known ones, I used these to control the fundamentality of the set of units. Moreover after a valuable discussion with Atsushi Sato from Tohoku University, Sendai I was able to continue some ideas of my above mentioned article and I constructed in the five possible cases $2<n<13$, n even, with the help of indicator functions families of number fields in two parameters with Galois group $D(_{n/2})$.

8. Please add your comments (if any):

The JSPS summer program is an excellent chance for foreign students to learn more about living and doing research in Japan during a two months stay; in addition it gave me the possibility to work concentrated on my research. It was a really great time which allowed me many valuable experiences in both aspects. I would like to thank the JSPS for giving me this opportunity and in particular Prof. Dr. Ken Nakamula for being such an open, interested and adjuvant host. Thank you very much.

9. (If any) Advisor's remarks:

The researcher Andreas Schöpp is a doctor course student of Professor Pohst, Michael, TU-Berlin, Germany, with whom I have been collaborating since 1987 on algorithmic number theory. When Andreas Schöpp started this research program seven weeks ago, he explained me about his results of constructing families of number fields of degree 4 with explicit fundamental units. During his stay he made a progress with extending his method to number fields of degree 5 employing the idea of " top down" construction of units.

I expect this will result in constructing new families with explicit fundamental units for this case in near future. On the other hand, I advised him another idea of utilizing " relative regulators" in a special case of degree 6. We are now discussing this problem and it will be our collaboration project. He also succeeded in giving new families of other types of fields via discussing with the audiences on his talk in Tokyo Metropolitan University.

RESEARCH REPORT

1. Name: Thomas Schwarzfischer (ID No.: SP04310)

2. Current affiliation: University of Passau, Germany

3. Research fields and specialties:

☐ Humanities ☐ Social sciences ☐ Mathematical and Physical Sciences
☐ Chemistry X Engineering Sciences ☐ Biological Sciences
☐ Agricultural Sciences ☐ Medical, Dental and Pharmaceutical Sciences
☐ Interdisciplinary and Frontier Sciences

4. Host institution: Kyoto University

5. Host researcher: Mutsunori Yagiura

6. Description of your current research

The quality/utility processor scheduling problem combines two kinds of flexibility in the specification of task sets. Functions of the time are used for generalizing both the notion of task completion and of deadlines. The model is general enough to allow for hierarchization of task sets, and/or semantics, cyclic precedence constraint graphs, nondeterministic release times, and heterogeneous multiprocessor architectures as target platforms.

General Quality / Utility Scheduling Problem

In the basic setting, the problem can be described as dynamic scheduling of a set of tasks on a single processor, where for the release times of tasks T_1,T_2,... only stochastic distributions are known in advance. On the other hand, we assume complete prior knowledge of two time-discrete functions associated with every task: a monotonically decreasing *utility function* mapping the time since the release of a task to a value domain, and a monotonically increasing *quality function* mapping the computation time to the same value domain. The quality function generalizes the wide-spread paradigm of run-to-completion tasks, where only two possible values exist for a task: none prior to the given execution time, and a positive maximum value afterwards. The utility function, on the other hand, generalizes the timeliness of tasks in real-times systems, usually expressed by deadlines, with value decreasing from a maximum to a minimum in an instant.

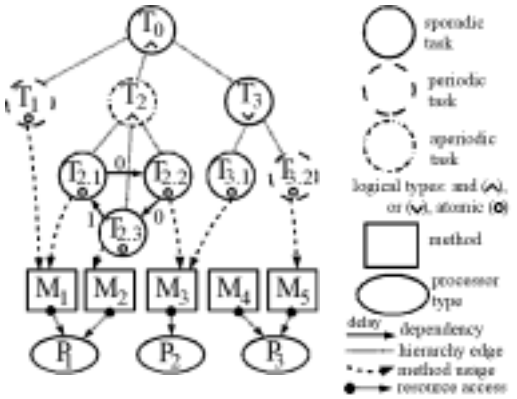
Letting t denote the absolute time, a set of functions τ_T for each task mapping absolute time to the progress of the task suffices to completely describe a schedule. The purpose of the dynamic scheduler is to allocate the processor to the individual tasks to maximize some objective function defined over quality and utility functions of all tasks. Among other possible objective functions we investigate into is the following:

$$\sum_T \max_{t' \leq t} u_T(t') \cdot q_T(\tau_T(t'))$$

subject to the constraints

- no task is allocated processing time prior to its release time
- the processor is not allocated to more than one task at a time

Alternative objective functions have been used to accommodate precedence constraints, hierarchical task networks, and/or semantics, multiprocessor target architectures, etc. An example graph for a very general setting of the quality / utility scheduling problem can be seen to the right.



Scheduling Algorithms and Simulation Environment

Several approaches to scheduling algorithms in the given problem setting have been devised. These include local-search algorithms (simulated annealing), meta-heuristic algorithms (tabu search), gradient search (Lagrangian optimization), and decision-theoretic methods (Markov decision processes). A simulation environment has been implemented to specify both scheduling algorithms and example loads and automatically evaluate the performance of the algorithms, components including a graphical editor, graph generators, a simulation tool with a series of visualization modes for the result data, and automatic benchmarking facilities with an underlying database system.

7. Research implementation and results under the program:

Title of your research plan:

Efficient methods for quality / utility scheduling problems

Description of the research activities:

Unfortunately, even restricted forms of the problem remain NP-complete, and the search space for objective functions like the one stated above are vary large, because the allocation of computation time at every instant of time matters. Even though this form of objective functions can be linked to real-world applications, other related existing problems exhibit objectives which seem to lend themselves more easily to less complex solutions. We now made a first attempt to develop efficient solutions for related problems with simpler objective functions.

Problems with the objective function given above are the potential for resource allocation to a task at any point in time after the release and the maximum operator requiring the objective function to be evaluated constantly. For these reasons, the value of a schedule depends on the exact position of resource allocations on the timeline. We now investigated the alternative objective function

$$\sum_T u_T(s_T) \cdot q_T(\tau_T(s_T))$$

where s_T is the stopping time of task T. For each task, evaluation of the objective function needs to take place only once, namely at its stopping time; no further computing time can be allocated after that. Once we decide on an order for the release and stopping times of the tasks and the execution time for all tasks, we know an optimal schedule exists which at any time executes the ready task with the earliest stopping time. However, even this simplified problem remains NP-complete, as it is an instance of the knapsack problem. A linear programming formulation can be found for the optimal stopping subproblem, but it remains unclear if this applies to the entire problem. For practical purposes, local search seem the most feasible solution; however, it remains to be seen how effort and performance correlate. The choice of neighbourhood is not trivial, as it must be powerful enough not to prevent or delay finding optima by construction. Search steps may consist of changes in the execution times only (considered to be less dramatic) or involve a change of order of release / stopping times. The assumption is that changing the execution order for subsets of more than two tasks simultaneously is necessary and that objective functions must be continuously differentiable for gradient-search methods to find maxima efficiently.

8. Acknowledgements: I would like to thank Prof. Hiroshi Nagamochi, Dr. Kenji Nonobe and Prof. Mutsunori Yagiura of Kyoto University for the interesting conversations I had with them during my stay at their institute in summer 2004. I am also grateful to the Japan Society for the Promotion of Science (JSPS) for funding the summer program, in which I was able to take part.

RESEARCH REPORT

1. Name: Sigrid Steller (ID No.: SP04311)

2. Current affiliation: DAAD

3. Research fields and specialties:

☐ Humanities ☐ Social sciences ☐ Mathematical and Physical Sciences

☐ Chemistry ☐ Engineering Sciences X Biological Sciences

☐ Agricultural Sciences ☐ Medical, Dental and Pharmaceutical Sciences

☐ Interdisciplinary and Frontier Sciences

4. Host institution: Max-Planck-Institute for Molecular Genetics, Berlin (Germany)

5. Host researcher: National Institute of Genetics, Mishima (Japan)

6. Description of your current research:

My PhD thesis concentrates on the analysis of *Neisseria meningitidis* with protein microarrays. *Neisseria meningitidis* is the major causative agent of bacterial meningitis. Over 500 000 cases occur each year, mainly during epidemics in Africa. As an exclusively human commensal and pathogen it has evolved mechanisms like phase variation to survive. Phase variation can be defined as the high frequency, reversible on-off switching of gene expression. In *Neisseria meningitidis* strain MC58 102 putative phase variable genes were identified. These genes were amplified by PCR and cloned into an expression vector. The corresponding proteins were expressed and 87 constructs could be purified. These proteins were used to generate protein microarrays. These arrays were screened with sera form patients suffering from meningitis and compared to age- and sex- matched controls. An Opa protein (NMB0442) could be identified in 11 of 20 patient sera. Opa proteins are highly phase- and antigenically variable and are important virulence factors.

I find this class of outer membrane proteins very interesting and wanted to investigate them in more detail using molecular evolutionary analyses.

7. Research implementation and results under the program (As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Positive selection of opa genes in *Neisseria meningitidis*

Description of the research activities:

Using the protein sequence of the opa gene (NMB0442) from the complete nucleotide sequence of the genome of *Neisseria meningitidis* strain MC58 a homology search was carried out. A homology search gives information about the same evolutionary origin serving different functions. The extracted sequences were translated and aligned. This process calculated all possible pairwise alignments among the sequences under study, identifying the pairs with the highest similarity score. This alignment was adjusted by hand and a phylogenetic tree was generated. The tree showed the evolutionary relationship of two major groups. These two main groups of opa cluster indicated that they must have separated early during evolution and were diverged into further subgroups by time. But it seemed that there has occurred quite a lot of geographical distribution. This pattern might be explained to horizontal gene transfer or recombination as published by some research groups. In the next step the hypervariable regions of the opa gene were analysed in more detail and the numbers of synonymous and nonsynonymous substitutions per site were calculated. The results showed in the case of evolutionary distance for these regions that nonsynonymous substitutions were greater than synonymous substitutions in some distinct groups. This refers on the DNA sequence level to positive selection, meaning an increase in the fitness of its carriers. Looking to a few sequences more closely it could be proved that recombination has taken place during evolution. That means changes occurred in the opa genes of these bacteria as they spread through the human population over a relatively short period of time. And by changes in amino acids of the opa locus, the bacteria *Neisseria meningitidis* is able to avoid the host immune response. Probably mutation and recombination within the opa loci generates sequence diversity that is subject to strong selection.

8. Please add your comments (if any):

Everyone in the lab was very kind and helpful, I learned a lot. I did not have much experiences before with DNA data analysis and by now I got a better understanding how to generate a phylogenetic tree, what is meant by synonymous, nonsynonymous substitutions and a lot more. I think that will be very helpful for my further career.

9. (If any) Advisor's remarks:

Ms. Steller has originally been trained as an experimentalist, and she wanted to learn bioinformatics in our laboratory. She worked quite hard during the period, and learned how to make a multiple alignment of molecular sequences, how to compute numbers of synonymous and nonsynonymous substitutions and detect natural selection, how to construct a phylogenetic tree, how to detect recombinations, and so forth. In this process, she learned not only the computer programs to compute these values, but also the theory behind them. We believe the experience in this laboratory would help her career a lot.

In addition, she communicated very well with laboratory members. She appeared to have learned much about Japanese culture. We believe this kind of activity would help making Japan as the leading country in the scientific field.

RESEARCH REPORT

1. Name: WARTLICK, Heidrun （ID No.: SP04312 ）

2. Current affiliation:

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3. Research fields and specialties:

☐ Humanities ☐ Social sciences ☐ Mathematical and Physical Sciences
☐ Chemistry ☐ Engineering Sciences ☒ Biological Sciences
☐ Agricultural Sciences ☒ Medical, Dental and Pharmaceutical Sciences
☐ Interdisciplinary and Frontier Sciences

4. Host institution:

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5. Host researcher: Prof. Kawashima

6. Description of your current research

Currently employed treatment options for patients with advanced and metastatic cancer are limited. In particular, the well known limitations of chemotherapy are crucial side effects and at least in part due to a lack of specificity. Antisense oligonucleotides (ASO) can be successfully employed to inhibit specifically gene expression and represent novel targets for cancer therapy. However, many oligonucleotide classes are polyanions and cannot passively transit the cell membrane. Therefore, many efforts have been made to overcome the severe problem. Colloidal drug delivery systems such as liposomes and nanoparticles are able to enhance their cellular uptake and protect them from enzymatic degradation. Nanoparticles are colloidal particles ranging in size from 10 to 1000 nm, and consisting of macromolecular materials in which the active compound is absorbed, encapsulated, or attached.

PLGA is a biodegradable and biocompatible copolymer that has been approved by the USA Food and Drug Administration for application in drug delivery. PLGA is an interesting polymer for the preparation of nanoparticles. Synthetic polymers have several advantages: no risk of bacterial and viral contamination, high purity and good reproducible quality of the polymer. PLGA offers a broad variety in polymer composition with regard to the content of each monomer as well as the molecular weight. This leads to different characteristics in polymer properties. PLGA nanoparticles are being extensively investigated for sustained delivery of therapeutic agents including DNA, proteins (Kawashima et al., 1998) and low molecular weight therapeutic agents.

7. Research implementation and results under the program:

Title of your research plan:

Tumor cell delivery of antisense oligonucleotide complexed by human serum albumin loaded PLGA nanoparticles

Description of the research activities:

The main objective of this study was to develop a novel drug carrier system for antisense oligonucleotides (ASO). Due to their hydrophilic and polyanionic character, oligonucleotides interact poorly with most polymeric materials. Therefore, the association and / or encapsulation of ASO in nanoparticles are difficult to achieve. In order to improve the loading efficiency of ASO, the use of human serum albumin is of special interest, as it possesses drug binding capacity. Moreover, to preserve integrity of the encapsulated ASO, modifications to the multiple emulsion method have been reported. The complexation of the drug with other macromolecules could increase its stability. The important problem of stability of ASO occurs not only during encapsulation into PLGA nanoparticles, but mainly during the degradation process of the PLGA polymer. Looking for the major causes of inactivation it is supposed that its acidic degradation products of PLGA disintegrate the ASO. The use of a blocking agent which would favorably interact with the polymer or buffer the acidic environment would be preferably. Human serum albumin (HSA) should be able to stabilize the sensitive ASO. Therefore, our study focused on the co-encapsulation of ASO together with human serum albumin onto PLGA nanoparticles prepared by two different preparation methods: emulsion solvent diffusion and double emulsion solvent evaporation method with slight modifications as established in the laboratory of Prof. Kawashima. The influence of various parameters on the loading efficiency of HSA, ASO and HSA/ASO complexes onto PLGA nanoparticles was evaluated regarding the addition of human serum albumin, the pH value and the concentration of the HSA solution.

As double emulsion solvent evaporation method in general use high speed homogenization or sonication and these shear forces were found to compromise ASO integrity and bioactivity, the emulsion solvent diffusion method was carried out as an alternative. In fact, the emulsion solvent diffusion method (nanoprecipitation) is recommended for the incorporation of hydrophobic drugs into polymeric nanoparticles. Nevertheless as described by several authors and also as demonstrated in this work, the establishment of a protocol that allows nanoprecipitation while avoiding extensive diffusion of the drug along with the solvent is possible.

For use in cell culture experiments the loading capacity is among the most critical parameter. A minimal loading capacity of 5 to 10 µg ASO / 1 mg PLGA nanoparticles is required to enable a clinical application of a concentration of 1 µM ASO. The ASO loading capacity of PLGA nanoparticles, which loaded ASO/HSA complexes at pH 4.7, was slightly higher than that observed of ASO/HSA complexes at pH 7.0. However, the drug loading was quite low. This low drug loading can be attributed to several factors. Firstly, the hydrophilic nature of ASO results in a significant loss of the drug to the external aqueous phase during the production process. Secondly, the small size will influence the drug loading: the small particles (210 to 320 nm) have a high surface area compared to their volume which means that a high proportion of the drug which is incorporated will be at or near the surface of the nanoparticle and can be readily released during nanoparticles production or during the removal of unincorporated drug. The amount of co-encapsulation of the stabilizer HSA did not show extraordinary improvement of the ASO loading capacity. The comparison of two different methods revealed that the loading capacity was in both cases very low and was not influenced by the formulation conditions. Finally, the release pattern of HSA and ASO from HSA/ASO complex loaded onto PLGA nanoparticles was investigated. Unexpectedly, the release of HSA from nanoparticle suspension was much higher compared to the release of ASO.

The results obtained from both preparation methods are not satisfactory and require further investigation. Instead of PLGA7520 copolymer, used in this study, a polymer with lower ratio of lactide / glycolide (50/50) could be used to overcome the low interaction of HSA/ASO complexes within the particle matrix.

9. (If any) Advisor's remarks:

Visiting Scientist, Ms Heidrun Wartlick organized so well her project and obtained a lots of data even in a short program, which should contribute to develop a novel drug carrier system for antisense oligonucleotides. She has established a base to promote further international cooperation of research between the University in Gifu and Frankfurt. Her enthusiastic studies in our laboratory stimulated significantly the activities of graduate students to deepen mutual understanding of science and culture in both countries.

RESEARCH REPORT

1. Name: Wellmann Philipp （ID No.: SP04313）

2. Current affiliation:

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3. Research fields and specialties:

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☐ Chemistry ☐ Engineering Sciences ☐ Biological Sciences
☐ Agricultural Sciences ☐ Medical, Dental and Pharmaceutical Sciences
☐ Interdisciplinary and Frontier Sciences

4. Host institution:

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5. Host researcher: Kazuhiko SEKI, Professor

6. Description of your current research

My main topics are lifetime, stability and performance of OLEDs as well as time resolved phosphorescent spectroscopy.
One of the main problems with organic light emitting diodes is their stability or lifetime. The rather short lifetime in comparison with liquid crystal applications can have a number of different reasons such as degradation of organic materials (emitter, matrix or transport),

diffusion of organic materials and changes in the interface characteristics of the numerous layers. My work is about charge carriers and their interaction with different interfaces as well as the degradation of emitter materials.
The time resolved phosphorescent spectroscopy measurement can be used to investigate both topics, but is currently only used for the degradation of emitter materials.
Also included in my research is the measurement of different OLED device architectures and their lifetime.

7. Research implementation and results under the program (As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Interface measurement on doped/undoped and undoped/doped structures using a large area Kelvin Probe.

Description of the research activities:

The standard organic LED produced in our Labs today usually has a complex structure like ITO/HTL/EBL/EL/EL/HBL/ETL/Metal with ITO: Indium Tin Oxide, HTL: hole transport layer, EBL: electron blocking layer, EL: emission layer, HBL: hole blocking layer, and ETL: electron transporting layer. Thus, it becomes increasingly important to understand the electronic structure at the numerous interfaces. This is specifically true if one includes electrical doping, which is an important aspect of devices with high efficiency, and also currently a major part of the work done at our Institute of Applied Photophysics in the Tech. University of Dresden. In our structures, we have a minimum of two doped layers with four different interfaces. In order to understand the electronic structure of interfaces, we are currently working on the subject using various approaches, including simulation, lifetime studies and time-resolved phosphorescent spectroscopy. The latter will help to understand the influence of the different carriers and interfaces on the device performance. Such information, though important, should also be obtained by a more direct method for studying the interfacial electronic structure. I have therefore tried to use a Kelvin Probe to investigate the doped/undoped and undoped/doped interfaces. In particular, the knowledge about the energy level alignment right at the interface and the possible band bending leading to Fermi level alignment in the organic layer are the most important issues. The knowledge, about the latter, is not

yet sufficient. I have started my work by measuring the conductivity of a doped organic layers, which is an effective proof, that the doped layers are actually working as planed. The lateral conductivity was shown to about 1E-5 S/cm which is sufficient for high performance devices.

After solving a couple of problems caused by different geometrical condition for different organic sources, it was finally possible to make the first measurements on the interface. For such a measurement series a gold contact is evaporated onto the stainless steel substrate, followed by a thick (50nm) organic ground contact. For the actual measurement a sequence of doped/undoped/doped/…/undoped layers is evaporated. A measurement point is taken after 2/4/10/20/50Å. Before starting the next layer in the sequence a reference was taken against the substrate. During these measurements though it was found, that the high diffusion nature of the doping material prevents a correct and precise measurement in this system. Making the interpretation of the results obtained impossible. It is very likely that the evaporated doping material changed the work function of the Kelvin Probe tip.

However I would like to note here the in principle it is possible to use the experiments described above, to get fundamental knowledge about the band bending of interfaces formed with doped electronic systems. This is important from the viewpoint of fundamental research, and will be useful for establishing guidelines for improving the device performances.

8. Please add your comments (if any):

Eventhough it was not possible to use the available setup to reach the goal of this project, I'm very happy to have stayed in this lab. Thank you very much to Prof. Seki and his lab for the very interesting two month. I also had the possibility to visit a number of different research institutes in Japan making some good contacts.