2. Advanced Materials, including Polymers and Nanomaterials

Japanese Coordinator:

Prof. Masao Doyama
Professor Emeritus
Faculty of Science and Technology,
Teikyo University of Technology

Indian Coordinator:

Dr. G. Sundrarajan
Director
International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Hyderabad

Advanced Materials, including Polymers and Nanomaterials

【Coordinators】

Japanese Coordinator	Indian Coordinator
Prof. Masao Doyama Professor Emeritus Faculty of Science and Technology Teikyo University of Technology	Dr. G. Sundrarajan Director International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Hyderabad

Overviews and Future Plan

【FY2002-2003 Overview】

1.1 Joint Research Projects

1.1.1 Materials Design by First Principles Computer Simulation
Coordinators: Prof. Yoshiyuki Kawazoe, Tohoku University and Professor S. Yashonath, Indian Institute of Science), From April 1999 to March 2003. (3 years)

Important results obtained are simulation of silicon fullerenes, water clathlates and carbon nanotubes using supercomputer system in the Institute for Materials Research. More than fifty papers have been published.

1.1.2. Investigation of the Optical and Electrical Properties of Tetrahedral Amorphous Carbon (ta-c) Film by Pulsed Laser Deposition
Coordinators: Professor Masayoshi Umeno, Chubu University and R. M. Mehra, University of Delhi, south, from April 2000 to March 2002. The project has been completed with great success.

N-type carbon (doped camphoric carbon)/p-type silicon heterojunction, p-type-carbon/n-type silicon heterojunction and n-type carbon/p-type carbon/p-type silicon heterojunction have been grown at Nagoya Institute of Technology and Chubu University and were analyzed by determining their solar cell parameters.

1.1.3. Preparation and Characterization of Thin Films of Conjugated Polymer Suitable for Optoelectronic Devices
Coordinators: Professor Mitsuyoshi Onoda (Himeji Institute of Technology) and Professor P. K. Batnagar, University of Delhi, South campus, from April 2002 to March 2005. (3 years)

Organic nano-materials with flexible structure is being investigated. The fundamental properties of devices are affected by interfacial properties.

1.1.4. Fabrication of Semiconductor Nanocrystals and Their Biosensor Application
Coordinators: Professor Shinji Nozaki, the University of Electro-Communications and Professor Surendra Nath Sahu, Indian institute of Physics, from April 2002 to March 2005. (3 years)

Electrical characteristics such as I-V and C-V of electrochemically deposited GaAs nanocrystals on ITO(indium tin oxide) coated glass substrates were measured. Gold or ITO contact were not ohmic. They are struggling to remove the contact.

1.2. Seminars:

1.2.1. FY2002: Two seminars were planned but both seminars were no held because the safety warning by the Ministry of Foreign Affairs.

1.2.1a Workshop on Advanced Magnetic and Magnetoelectric Materials and Devices, Hiroyuki

Akinaga, National Institute of Advanced Industrial Science and Technology, and Professor Sukumar Basu, Indian Institute of Technology, Kharagpur). First planned to be held in India but changed to Japan. Never be held.

1.2.1b. Materials Design by First Principles Computer Simulation. Planned by Professor Yoshiyuki Kawazoe, Tohoku University and Professor S. Yashonath, Indian Institute of Science, on the occasion of the completion of joint research project. Also not be held.

1.2.2. FY2003: Two seminar were held.

12.2a. India-Japan Seminar on Materials Education, Research Strategy and Advanced Materials. Coordinators: Professor Masao Doyama, University of Tokyo and Teikyo University of Science and Technology and Professor Pallerama Rama Rao, International Advanced Research Center for Powder Metallurgy and New Materials.

Professor CNR Rao (Founding President, MRS-I) gave an invited talk on “Electronic Phase Separation in Solids” in Symposium B-8, IUMRS-ICAM (International Union of Materials Research Societies-International Conference on Advanced Materials), Professor P. Rama Rao is the Vice President of IUMRS (International Union of Materials Research Societies) and Dean S. V. Subramanyam is the Vice President of MRS-I. It was quite a rare occasion for such important Indian scientists to visit Japan together, so that a Japan-India seminar was planned and held in the same building wjere IUMRS-ICAM was held. Materials Education and Research were held joint with IUMRS-ICAM. New Materials was held independent from IUMRS-ICAM, the speakers are the representatives from Japan and India but audience was not restricted to hear the symposium. The chair men of the India-Japan Cooperative Science Programme, Professor S. Nagakura and Professor CNR Rao, and Professor K. Iga,, the Executive Director of JSPS gave welcome addresses and invited talks. The symposium was quite successful.

1.2.2.b. India-Japan Workshop on Advanced Molecular Electronic and Bionics
Coordinators: Professor Keiichi Kaneto, Professor, Kyushu Institute of Technology and Dr. Bansi D. Malhotra, Scientist F, National Physical Laboratory, New Delhi.

The aim of workshop was to active researchers from both countries by presenting and exchanging their recent outstanding results on Advanced Molecular Electronics and Bionics and related topics, and to contribute the promotion of science and technology in Asian countries.

In this workshop 13 delegates from India and 29 Japanese participants gave plenary lecture, invited talks and poster presentation for two days scientific program. More than 30 students participated to the workshop and listened eagerly to the topics. The topics are important technologies, which are designed to reduce the energy consumption and environmental pollution, and to develop bio and organic materials based electronic devices to perform the high efficient energy conversion as well as bio mimetic sensing and information processing. Contents of the key topics are following, [FM] Organic Functional Materials (Organic conductors, Electroactive polymers, Sensor, Optical materials), [BM] Biomaterials and Biosensors (Biosensors, Biomaterial, Bioelectronics), [OD] Organic and Molecular Opto-Electronics Devices (Diode, Solar cell, Transistors, EL), [NS] Nano Structures and Characterization (Self assembly, Layer structure, Nano Fabrication, Fullerenes, Carbon nanotube). Among them 39 selected papers were picked up as the proceedings in the journal of Current Applied Physics2004 (Elsevier). Many Japanese students have experienced the aggressive international workshop especially with Indian scientists. This is a very important result of this workshop, which was held in a small city apart from metropolitans.

The banquet with an attraction and the visiting a chemical company of Mitsubishi Chemicals were planed. As the post conference tour, all of Indian delegates and Japanese participants visited the Atomic Bomb Museum and the Historic area at Nagasaki City and deepened friendships between two countries. The seminar finished with great success, which was bring out by the praises from

participants.

【FY2004-2005 Future Plan】

2.1.1. Preparation and Characterization of Thin Films of Conjugated Polymer Suitable for Optoelectronic Devices
Coordinators: Professor Mitsuyoshi Onoda (University of Hyogo) and Professor P. K. Batnagar, University of Delhi, South campus, from April 2002 to March 2005. (3 years)

Professor Mitsuyoshi Onoda (University of Hyogo) has visited Professor P. K. Batnagar in December, 2004 and Dr. Bhatnagar Pramod Kumar and P. C. Mather have visited Professor Onoda in August 2004.

Organic nano-materials with flexible structure is being investigated. The fundamental properties of devices are affected by interfacial properties.

2.1.2. Fabrication of Semiconductor Nanocrystals and Their Biosensor Application
Coordinators: Professor Shinji Nozaki, the University of Electro-Communications and Professor Surendra Nath Sahu, Indian institute of Physics, from April 2002 to March 2005. (3 years)

Professor Surendra Nath Sahu, Indian institute of Physics is visiting Professor Nozaki in December, 2004.

Electrical characteristics such as I-V and C-V of electrochemically deposited GaAs nanocrystals on ITO(indium tin oxide) coated glass substrates were measured. Gold or ITO contact were not ohmic. They are struggling to remove the contact.

2. Seminars

2.1. Indo-Japan Workshop on Solvothermal Reactions
Coordinators: Professor Masahiro Yoshimura, Tokyo Institute of Technology and Professor K. byrappa, University of Mysore

August 24, 2004 to August 27, 2004 (4 days）
at University of Mysore.

The main objectives of these meetings are to discuss the issues related to the science and technology of solvothermal reactions by promoting interactions among scientists drawn from various sectors like academic, industrial and corporate, etc., from India and Japan. There will be plenary lectures by invited speakers and oral presentations by specialists and active researchers in the field. This year it will be hosted at University of Mysore.

Expected Effects: The expected effects of this conference are to address the key issue associated with the science and technology of solvothermal reactions and to exchange our knowledge and information in this area. The timing of the 6^{th} conference is especially fortuitous given world-wide initiatives in related areas such as mineralogy, solution chemistry, crystal growth, soft solution processing, industrial ecology, advanced materials, and nanotechnology.

In this regard, Japan and India are in the leading positions in the world. Therefore, this conference enabled us to make intimate relations and future developments.

2.2
New materials priority area is most important area and the area should be emphasized.

【Summary】

In FY2002 and FY2003:
Three Joint Research Projects were performed.

1.1.1 Materials Design by First Principles Computer Simulation

Coordinators: Prof. Yoshiyuki Kawazoe, and Professor S. Yashonath, From April 1999 to March 2003. (3 years)
Important results obtained are simulation of silicon fullerenes, water clathlates and carbon nanotubes using supercomputer system in the Institute for Materials Research. More than fifty papers have been published.

1.1.2. Preparation and Characterization of Thin Films of Conjugated Polymer Suitable for Optoelectronic Devices
Coordinators: Professor Mitsuyoshi and Professor P. K. Batnagar, from April 2002 to March 2005. (3 years)

Organic nano-materials with flexible structure is being investigated. The fundamental properties of devices are affected by interfacial properties.

1.1.3. Fabrication of Semiconductor Nanocrystals and Their Biosensor Application
Coordinators: Professor Shinji Nozaki, and Professor Surendra Nath Sahu, from April 2002 to March 2005. (3 years)

Elecrical characteristics such as I-V and C-V of electrochemically deposited GaAs nanocrystals on ITO(indium tin oxide) coated glass substrates were measured. Gold or ITO contact were not ohmic. They are struggling to remove the contact.

1.2. Seminars:

1.2.1. FY2002: Two seminars were planned but both seminars were no held because the safety warning by the Ministry of Foreign Affairs.
1.2.2. FY2003: Two seminar were held.

12.2a. India-Japan Seminar on Materials Education, Research Strategy and Advanced Materials.
Coordinators: Professor Masao Doyama, and Professor Pallerama Rama Rao,.

In conjunction with IUMRS-ICAM Seven Indian Scientists including Prof. CNR Rao and P. Rama Rao attended the Japan-India Seminar. The chair men of the India-Japan Cooperative Science Program, Professor S. Nagakura and Professor CNR Rao, and Professor K. Iga,, the Executive Director of JSPS gave welcome addresses and invited talks. The symposium was quite successful.

1.2.2.b. India-Japan Workshop on Advanced Molecular Electronic and Bionics
Coordinators: Professor Keiichi Kaneto, and Dr. Bansi D. Malhotra,

In this workshop 13 delegates from India and 29 Japanese participants gave plenary lecture, invited talks and poster presentation for two days scientific program. More than 30 students participated to the workshop and listened eagerly to the topics. This was a very important result of this workshop, which was held in a small city apart from metropolitans.

Implementation Chart of Program

Advanced Materials, including Polymers and Nanomaterials

FY	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Research Project		1. structure Characterisation of Advanced Multilayer Materials by High-resolution X-Ray Techniques I:6m/32md J:1m/8 md I:1m/8md J:1m/6 md I:2m/18md										
			2.Fabrication, Analysis and Measurement for New Magnetic Thin Film Materials for Recording Applications J:2m/24md J:2m/34md I:2m/42md I:2m/22md									
				3.Laser Induced Crystallization of Hydrogenated Amorphous Silicon a Si-H J:1m/11md J:1m/11md I:1m/28md I:2m/48md J:2m/16md I:3m/59md								
							4.Materials Design by First Principles Computer Simulation J:1m/8md I:2m/25md J:2m/27md :I3m/122md J:2m/23md I:1m/29md					
							5.Investigation of the Optical and Electrical Properties of Tetrahedral Amorphous Carbon(ta-C) Films by Pulsed Laser Deposition and Application to Photovoltaic Device I:2m36md I:2m/44md I:2m18md					
										6.Preparation and Characteriztion of Thin Films of Conjugated Polymers Suitable for Optoelectronic Devices J:1m/6md I:2m30md J:2m/44md		
										7.Fabrication of semiconductor nanocrystals and Their Biosensor Applicatation I:1m/9md		

FY	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Seminar		★ 1.Seminar on New Materials, Oct.17-18, Tokyo I:4m/23md		★ 2.Japan-India Joint Sminar on Computational Materials Science, Oct. 21-22, Hyderabad J:7m/47md		★ 3.India-Japan Joint Seminar on Oxide Electronics Feb.23-24, Chiba I:5m/39md						
						★ 4.Application of the 3MV Ultrahigh Voltage Electron Microscope to Materials Science, Oct.9-10, Bangalore J:2m/12md						
						★ 5.India-Japan Joint Seminar on Computational Materilas Science, Oct. 12, Bamgalore J:4m/23md						
						★ 6.India-Japan Workshop on Advanced Fibers and Composites, Dec 6-9, Vallabh Vidyanagar J:5m/40md						
						★ 7.Workshop on Smart Materials and Structures, November 23-25, New Delhi I:6m/24md						
									★ 8.India-Japan seminar on Materials Education, Reseach Strategy and Advanced Materials, October 10-12 J:9m/42md I:7m/45md			
									★ 9.India-Japan seminar on Materials Education, India – Japan Workshop on Advanced Molecular Electronics and Bionics, December 11-13		J:7m/14md I:9m/55md	
Visiting Scientists		I:1m/31md	J:1m/7md I:6m/149md	I:1m/60md	I:1m/63md	I:1m/16md	J:1m/6md I:3m/32md	J:1m/11md I:3m/73md	J:4m/45md I:1m/43md			
Total		I:8m/86md	J:5m/50md I:7m/157md	J:9m/62md I:9m/145md	J:2m/34md I:5m/183md	J:8m/51md I:6m/97md	J:7m/54md I:5m/57md	J:9m/62md I:8m/231md	J:6m/68md I:4m/116md	J:1m/6md I:5m/57md	J:16m/56md I:18m/144md	

Report

1. Joint Research Projects

1-1 Project 1			
Title		Materials Design by First Principles Computer Simulation	
Principal Investigator	Japan	Prof. Yoshiyuki Kawazoe, Professor, Tohoku University	
	India	Prof. S. Yashonath, Professor, Indian Institute of Science	
Period		From 1999 to 2001	
No. of Exchange	FY2001	Japan to India 1m/ 8md	India to Japan 2m/ 25md
	FY2002	J to I 2m/ 27md	I to J 13m/ 122md
	FY2003	J to I 2m/ 23md	I to J 1m/ 29md

Objectives :

Based on the recent supercomputer power, which the Institute for Materials Research, Tohoku University (IMR) can support, and rapid progress in the first principles computer simulation methods, it is decided to start international collaboration between Indian researchers who have high level knowledge in quantum mechanical formulation and Japanese researchers having advanced technological understanding of computer simulation for materials design. This team was organized based on the long term collaboration between IMR and IIS (Indian Institute for Science) in Bangalore, India. We have selected the program TOMOBO (Tohoku university Mixed-Basis Orbitals first principles computer simulation package) as the basis of the collaboration, and the program is expected to be applied to presently interested materials for nanotechnology.

Accomplishment Status :

It was successful to develop the code TOMBO to be applicable to crystals in general, which part was not included before hand. The program was used collaboratively to analyze the dynamic behavior of methane molecules in zeolite and hydrogen molecules in ice. These works were done by using the supercomputer at IMR with really a large scale computation, which could not be performed in other institutions. Accordingly, we have published the obtained results in worldly known scientific journals and in international conferences as invited talks.

Future Plan :

Because of the successful ending of this collaboration, we plan to keep in working as an international research group. In 2004, in Kawazoe's laboratory, there are 5 Indian researchers working based on this collaborative initiative. They are working on the exact subject of this project of the materials design by the first principles computer simulation. Subjects are expanding to include from very basic research to industrially interested materials. The future plan at the moment seems to be fruitful and more support from the Government is necessary to realize the plan.

1-2 Project 2				
Title		Investigation of the Optical and Electrical Properties of Tetrahedral Amorphous Carbon (ta-C) Films by Pulsed Laser Deposition and Application to Photovoltaic Device		
Principal Investigator	Japan	Prof. Masayoshi Umeno, Professor, Chubu University		
	India	Prof. R.M. Mehra, Professor, University of Delhi South Campus		
Period		From 2000 to 2003		
No. of Exchange	FY2000	Japan to India 0m/ 0md	India to Japan	2m/ 36md
	FY2001	J to I 0m/ 0md	I to J	2m/ 44md
	FY2002	J to I 0m/ 0md	I to J	2m/ 18md

Objectives :

a) Growth of doped camphoric carbon (CC) fils on Quartz, Glass and ITO substrates using XeCl excimer pulsed laser deposition and ion beam sputtering
b) Optimization of deposition parameters to achieve the required optical band gap and resistivity
c) Characterization of thin films for their structural, optical and electrical properties using XRD, FTIR Raman spectroscopy, SEM and AFM
d) Fabriacation of hetro-structures & homo-structures (p-i-n) solar cells using the CC films
e) Determination of the various solar cell parameters V_{oc}, I_{sc}, FF and Efficiency
f) Determination of the various solar cell parameters (Experimentally as well as Theoretically)
g) Intensity and temperature variation study and estimation of the Series Resistance of the CC solar cell by using the family of curves of intensity variation
h) Study of the photo degradation of the solar cell parameters due to light soaking

Accomplishment Status :

The CC films and their heterostructures namely; n-C/p-Si heterojunction, p-C/n-Si heterojunctino and n-C/p-C/p-Si heterojunction have been grown at NIT, Nagoya, and Chubu University, Kasugai, Japan. The heterostructures were analyzed by determining their solar cell parameters. From the study made at Department of Electric Science, University of Delhi South Campus, New Delhi, India and Chubu University, Kasugai, Japan, three joint research papers have been published in refereed journals and two has been presented (one Orally) in the International Conference on 'PV in Europe' From Energy solution to PV technology, Rome, Italy from October 7-11, 2002. One paper has also been accepted in the WCPEC conference to be held in Osaka, Japan during May 12-16, 2003.

1-3 Project 3				
Title		Preparation and Characterization of Thin Films of Conjugated Polymers Suitable for Optoelectronic Devices		
Principal Investigator	Japan	Prof. Mitsuyoshi Onoda, Professor, University of Hyogo, Graduate School of Engineering		
	India	Prof. P.K.Bhatonagar, Professor, Delhi University		
Period		From 2002 to 2004		
No. of Exchange	FY2002	Japan to India 1m/6md	India to Japan	2m/30md
	FY2003	J to I 2m/44md	I to J	0m/ 0md
	FY2004	J to I 0m/ 0md	I to J	0m/ 0md

Objectives :

Electronic and optically functional devices using organic nano-materials with flexible structure have been developing to the stage of practical use. To improve the performance and the function of such devices, the profound understanding of electronic phenomena at the interface is critically important. Accordingly, it is necessary to understand what the “intelligence” of interface systems is and use intentionally the “intelligence” for the better performance. The object of our project shall be to discuss basics and applications in terms of organic optoelectronic devices.

Accomplishment Status :

We participate in the International Symposium on ADVANCED MATERIALS AND PROCESSING (ISAMAP-2K4), which will be held in Indian Institute of Technology (Kharagpur) on December 6-8 and report our results by the following title:

“Unique Sign Inversion of Photocarrier of Poly(3-octadecylthiophene) at Around Melting Point”, by M.Onoda, K.Tada, P.K.Bhatnagar, and P.C.Mathur.

Future Plan :

Our goal is to realize not only organic thin film optoelectronic devices, but also mono-molecular film optoelectronic devices in its turn molecular electronic devices. Especially, because interfaces consisting of organic/metal and organic/organic are necessary in organic optoelectronic devices, the electronic phenomenon at the interface is critically important to the performance and the function such devices. Accordingly, in order to realize organic electronic devices, we intend to continue our research project more and more.

1-4 Project 4			
Title		Fabrication of Semiconductor Nanocrystals and Their Biosensor Application	
Principal Investigator	Japan	Prof. Shinji Nozaki, Professor, The University of Electro-Communications	
	India	Prof. Surendra Nath Sahu, Assistant Professor, Institute of Physics	
Period		From 2002 to 2004	
No. of Exchange	FY2002	Japan to India 1m/9md	India to Japan 0m/0md
	FY2003	J to I 0m/0md	I to J 0m/0md
	FY2004	J to I 1m/14md (tentative)	I to J 1m/14md (tentative)

Objectives :

The objectives of the research project are to: (1)develop a technique to deposit nanocrystals with a good control of the size and positioning and (2)explore a potential application of semiconductor nanocrystals to biosensors. The Japanese team characterizes the nanocrystals synthesized by the Indian team, who proposes a potential application to biosensors based on optical properties modified with DNA surfactants.

Accomplishment Status :

In FY2002, Mr. Nayak, a Ph. D. student of Prof. Sahu's then, visited Prof. Nozaki for 10 days and made the electrical measurements on GaAs nanocrystals deposited on ITO-coated quartz substrates. These experimental results were analyzed with Prof. Nozaki's assistance, and the Indian team submitted several papers on electrical and optical characterizations of the GaAs nanocrystals with Prof. Nozaki as a coauthor. Dr. Nayak joined Prof. Nozaki's lab as a postdoctoral research fellow after completing his Ph.D in November 2004. His job at Prof. Nozaki's lab is to help the Japanese team chemically synthesize semiconductor nanocrystals for LED application and to strengthen the collaboration with the Indian team.

In FY2003, JSPS was not able to support Prof. Nozaki's collaboration with Prof. Sahu due to a limited budget but was able to resume support in FY2004. In FY2004, Prof. Nozaki was invited to the US-India Workshop on Nanoscale Materials held at Institute of Physics (IOP). Prof. Sahu was one of the organizers. During his visit to IOP, Prof. Nozaki discussed the details of the joint project, in particular effects of the DNA surfactants on the PL characteristics of the CdSe nanocrystals. After the discussion, both agreed to further investigate the PL characteristics with various kinds of DNA surfactants and explore a potential application to biosensors. Since the workshop was held at the beginning of April, Prof. Nozaki's travel expense was not paid by the JSPS-DST program.

At the workshop, Prof. Sahu introduced Dr. Sharma, Director of International Division at DST, to Prof. Nozaki. It was clear at the workshop that the U.S. research on nanomaterials had moved forward to the application stage from science, while most of the Indian researchers still showed less interest in applications and tended to place more value on publications. However, Dr. Sharma and Prof. Sahu believed that the industrial people should be also involved in high technology in the field of nanomaterials through collaboration with the researchers in India. Prof. Sahu invited the industrial people to the workshop but no one from the industry attended it. Profs. Nozaki, Sahu and Dr. Sharma had an intensive discussion on how the companies in India would be able to receive benefits from research activities in the field of nanomaterials in India. Dr. Sharma said that the companies in India would show no interest in nanomaterials unless the application was clearly defined. Prof. Nozaki thought that there were many potential applications of the accomplishments of nanomaterials research in India. Someone only needs to propose a particular application for each research accomplishment. He thought the Japanese industry could play such a role. Once the applications are well defined, the Indian companies will show a great interest in working with the Japanese companies. As the first step, they proposed a seminar for matchmaking between the Indian researchers and the Japanese companies, which might see the research accomplishments

made by the Indian researchers as seeds for new business. The DST has been spending a large amount of money on nanomaterials research, hoping the research outcomes will soon lead to economic growth in India by bringing about many business opportunities. Profs. Nozaki, Sahu and Dr. Sharma proposed to jointly organize a seminar to be held in Japan in the near future by inviting the Indian researchers and the Japanese industrial people.

After Prof. Nozaki returned to Japan, he discussed their proposal with Dr. Shanker, S & T Counsellor at Indian Embassy in Tokyo, who also supported the proposal. Dr. Shanker and Prof. Nozaki also had a meeting with Mr. Hachiyama, Deputy Director of Asian and Pacific Division of International Trade Policy Bureau at Ministry of Economy, Trade and Industry and asked for his support to invite the Japanese companies to the seminar. Dr. Sharma has started asking the related government agencies for support, as seen in the attached letter. Prof. Sahu has started contacting the researchers in the filed of nanomaterials to encourage them to participate in the seminar.

In January 2005, Prof. Sahu will visit Prof. Nozaki through the JSPS-DST program. Although the program supports only 14 days of his visit, Prof. Nozaki will provide him with financial support for his extended stay at the University of Electro-Communications. During his stay, Profs. Nozaki and Sahu will have extensive discussion on both the JSPS-DST project and the seminar to be organized. Profs. Sahu and Nozaki will visit Dr. Shanker to make a detailed plan of the seminar together. Dr. Sen, Prof. Nozaki's postdoctoral research fellow, will be introduced to Prof. Sahu and after Prof. Sahu returns to his institute, Dr. Sen will visit Prof. Sahu for 14 days to carry out biosensor experiments.

In summary, Prof. Nozaki's collaboration with Prof. Sahu through the JSPS-DST program in FY2004 is fruitful not only in the project itself but also in a seminar to be organized for matchmaking between the Japanese companies and the Indian researchers.. Although his visit was not financially supported by the JSPS-DST program, Prof. Nozaki's participation in the US-India workshop was very fruitful. During his visit, Prof. Nozaki was able to meet Dr. Sharma at DST and make him interested in the seminar to matchmake the Japanese companies and the Indian scientists. Dr. Sharma is a right official to obtain various government supports in India to organize the seminar. Prof. Sahu has contact with many Indian researchers in the field of nanomaterials. It was extremely important that Profs. Sahu, Nozaki and Dr. Sharma had an opportunity to extensively discuss an importance of applications of nanomaterials research in India and agreed to jointly organize a seminar to provide both Japanese companies and Indian nanomaterials researchers with a matchmaking opportunity.

Future Plan :
In FY2005, Profs. Sahu, Nozaki and Dr. Sharma will make a detailed plan of the seminar, which is to be held in Japan in fall 2005 or spring 2006. They will contact the related government agencies (JSPS, METI or DST) for financial support for the seminar. Prof. Sahu makes a list of the activities of the researchers in the field of nanomaterials in India who are willing to develop the product with help from the Japanese companies, and Prof. Nozaki shows the list to Japanese companies. Only the researchers from India whose research activities have attracted the companies will be invited to exchange their thoughts with the people from the Japanese companies at the seminar. Profs. Sahu, Nozaki and Dr. Sharma hope to make a great success in the seminar and are committed to help Japan and India develop new nanomaterials business together based on the Indian research activities in the field of nanomaterials.

*** Exchange Visits Undertaken**

Japan to India

No. of Project	Name & Affiliation	Research Subject	Main Host Researcher	Period
Project 1 (FY2001)	Prof. Vijaj Kumar	Material Design by First Principles Computer Simulation	Prof. S.Yashonath, Professor, Indian Institute of Science	2001/11/26-2001/12/12 (17 days)
Project 1 (FY2001)	Prof. Yoshiyuki Kawazoe, Professor, Tohoku University	Material Design by First Principles Computer Simulation	Prof. U. Waghmare	2001/11/27-2001/12/02 (6 days)
Project 3 (FY2002)	Prof. Mitsuyoshi Onoda, Professor, Himeji Institute of Technology, Graduate School of Engineering	Preparation and Characterization of Thin Films of Conjugated Polymers Suitable for Optoelectronic Devices	Prof. P.K. Bhatnagar, Professor, University of Delhi	2002/12/15-2002/12/20 (6 days)
Project 3 (FY2003)	Prof. Mitsuyoshi Onoda, Professor, Himeji Institute of Technology, Graduate School of Engineering	Preparation and Characterization of Thin Films of Conjugated Polymers Suitable for Optoelectronic Devices	Prof. P.K. Bhatnagar, Professor, University of Delhi	2003/12/15-2003/12/20 (6 days)

India to Japan

No. of Project	Name & Affiliation	Research Subject	Main Host Researcher	Period
Project 1 (FY2001)	Prof. S.Yashonath, Professor, Indian Institute of Science	Material Design by First Principles Computer Simulation	Prof. Akira Miyamoto,	2002/02/18-2002/03/18 (29 days)
Project 2 (FY2001)	Prof. R.M. Mehra, Professor, University of Delhi South Campus	Investigation of the Optical and Electrical Properties of Tetrahedral Amorphous Carbon (ta-C) Films by Pulsed Laser Deposition and Application to Photovoltaic Device	Prof. Masayoshi Umeno, Professor, Chubu University	2001/12/22-2002/01/12 (22 days)
Project 2 (FY2001)	Prof. A.Kapoor, Leader, University of Delhi, South Campus		Prof. Masayoshi Umeno, Professor, Chubu University	2001/12/22-2002/01/12 (22 days)

Project 2 (FY2002)	Prof. R.M. Mehra, Professor, University of Delhi South Campus	Investigation of the Optical and Electrical Properties of Tetrahedral Amorphous Carbon (ta-C) Films by Pulsed Laser Deposition and Application to Photovoltaic Device	Prof. Masayoshi Umeno, Professor, Chubu University	2003/03/08-2003/03/16 (9 days)
Project 2 (FY2002)	Prof. A.Kapoor, Leader, University of Delhi, South Campus		Prof. Masayoshi Umeno, Professor, Chubu University	2003/03/08-2003/03/16 (9 days)
Project 3 (FY2002)	Prof. P.K. Bhatnagar, Professor, University of Delhi, South Campus	Preparation and Characterization of Thin Films of Conjugated Polymers Suitable for Optoelectronic Devices	Prof. Mitsuyoshi Onoda, Professor, Himeji Institute of Technology, Graduate School of Engineering	2002/07/22-2002/08/05 (15 days)
Project 3 (FY2002)	Prof. P.C. Mathur, Professor, University of Delhi, South Campus	Preparation and Characterization of Thin Films of Conjugated Polymers Suitable for Optoelectronic Devices	Prof. Mitsuyoshi Onoda, Professor, Himeji Institute of Technology, Graduate School of Engineering	2002/07/22-2002/08/05 (15 days)
Project 4 (FY2002)	Dr. Jhasaketan Nayak, Research Scholar, Institute of Physics	Fabrication of Semiconductor Nanocrystals and Their Biosensor Application	Prof. Shinji Nozaki, Professor, The University of Electro-Communications	2003/01/21-2003/01/29 (9 days)
Project 3 (FY2003)	Prof. P.C. Mathur, Professor, University of Delhi, South Campus	Preparation and Characterization of Thin Films of Conjugated Polymers Suitable for Optoelectronic Devices	Prof. Mitsuyoshi Onoda, Professor, Himeji Institute of Technology, Graduate School of Engineering	2003/05/21-2003/06/11 (22 days)
Project 3 (FY2003)	Dr. Jhasaketan Nayak, Research Scholar, Institute of Physics	Fabrication of Semiconductor Nanocrystals and Their Biosensor Application	Prof. Shinji Nozaki, Professor, The University of Electro-Communications	2003/05/21-2003/06/11 (22 days)

2. Seminars

2-1 Seminar 1	
Title	India – Japan seminar on Materials Education, Research Strategy and Advanced Materials
Japanese Organizer	Prof. Masao Doyama, Professor Emeritus, Teikyo University of Science & Technology
Indian Organizer	Prof. Pallerama R. Rao, Professor, International Advanced Research Center for Powder Metallurgy and New Materials
Period & Place	From October 10, 2003 to October 12, 2003 ,

Objectives :
International Union of Materials Research Societies (IUMRS)-International Conference on Advanced Materials (ICAM2003) was held in Yokohama in October, 2003. It was a very good chance to organize the Japan-India Symposium near the date of IUMRS-ICAM.

Accomplishment Status :
The Japan-India Symposium was consisted of two parts. One was on "Materials and Research" and the other was "Advanced Materials". In the afternoon of October 10, 2003 was joint with IUMRS-ICAM but the talks were only by Japanese and Indian scientists. The audience were not limited to Japanese and Indian scientists. On October 12, the new development of advanced materials are reported. It was very fortunate that Professors C. N. R. Rao and Saburo Nagakura, the Co-Chairmen of the Japan-India Science Council, Professor Kenichi Iga and Professor P. Rama Rao, Indian Coordinator, New Materials gave welcome addresses at the symposium.

Program :
October 9
Welcome Speech: Masao Doyama , P. Rama Rao and Kenichi Iga
Session F1-1
7 Invited Lecturers

October 10
Session F1-3
1 Invited Lecturer

October 11
Session F1-1
1 Invited Lecturer
October 12
Welcome Speech: Masao Doyama and P. Rama Rao
6 Lecturers
Welcome Speech: Saburo Nagakura
8 Lectures

List of Participants :	
From Japan	
Saburo Nagakura	President, The Japan Academy
Kenichi Iga	Japan Society for the Promotion of Science
Masao Doyama	Professor Emeritus, Tokyo University of Science and Technology
Katsuro Oda	Associate Professor, University of Tokyo, Institute of Industrial Science
Hideomi Koinuma	Professor, Tokyo Institute of Technology
Osamu Takai	Professor, Nagoya University
Shigeo Asai	Professor, Nagoya University
Atsushi Suzuki	Professor, Yokohama National University
Akira Miyamoto	Professor, Graduate School of Engineering, Tohoku University
From India	
C. R. N. Rao	Professor, Jawaharlal Nehru Center for Advanced Scientific Research
P. Rama Rao	Professor, International Advanced Research Centre for Powder Metallurgy and New Materials
C. Chakravorty	President MRS-I Mahendra Lal Sircar Professor of Physics, Indian Association for the Cultivation of Science
S.V. Subramanyam	Faculty of Science and Professor, Indian Institute of Science
Pushan Ayub	Associate Professor, Tata Institute of Fundamental Research
Shobhana Narasimham	Associate Professor, Jawaharlal Nehru Centre for Advanced Scientific Research
T. Pradeep	Associate Professor, Indian Institute of Technology, Chennai

2-2 Seminar 2	
Title	India – Japan Workshop on Advanced Molecular Electronics and Bionics
Japanese Organizer	Prof. Keiichi Kaneto, Professor, Kyushu Institute of Technology
Indian Organizer	Dr. Bansi D. Malhotra, Scientist F, National Physical Laboratory, New Delhi
Period & Place	From December 11, 2003 to December 13,2003 ,

Objectives :

The aim of workshop is to active researchers from both countries by presenting and exchanging their recent outstanding results on Advanced Molecular Electronics and Bionics and related topics, and to contribute the promotion of science and technology in Asian countries.

Accomplishment Status :

In this workshop 13 delegates from India and 29 Japanese participants gave plenary lecture, invited talks and poster presentation for two days scientific program. More than 30 students participated to the workshop and listened eagerly to the topics. The topics are important technologies, which are designed to reduce the energy consumption and environmental pollution, and to develop bio and organic materials based electronic devices to perform the high efficient energy conversion as well as bio mimetic sensing and information processing. Contents of the key topics are following, [FM] Organic Functional Materials (Organic conductors, Electroactive polymers, Sensor, Optical materials), [BM] Biomaterials and Biosensors (Biosensors, Biomaterial, Bioelectronics), [OD] Organic and Molecular Opto-Electronics Devices (Diode, Solar cell, Transistors, EL), [NS] Nano Structures and Characterization (Self assembly, Layer structure, Nano Fabrication, Fullerenes, Carbon nanotube). Among them 39 selected papers were picked up as the proceedings in the journal of Current Applied Physics2004 (Elsevier). Many Japanese students have experienced the aggressive international workshop especially with Indian scientists. This is a very important result of this workshop, which was held in a small city apart from metropolitans.

The banquet with an attraction and the visiting a chemical company of Mitsubishi Chemicals were planed. As the post conference tour, all of Indian delegates and Japanese participants visited the Atomic Bomb Museum and the Historic area at Nagasaki City and deepened friendships between two countries. The seminar finished with great success, which was bring out by the praises from participants.

Program :

December 11

Session 1	Plenary Lecture and Biomaterials and Sensors (BM1)
Session 2	Biomaterials and Sensors (BM1)
Session 3	Biomaterials and Sensors (BM1), and Nano-Structures(NS1)
Session 4	Organic Devices & Functional Materials (OD1)

December 12

Session 5	Organic Devices (OD2)
Session 6	Nano Structure (NS2)
Session 7	Bio-material & Sensors (BM2)
Session 8	Functional Materials (FM2)
Poster Session	

List of Participants :

From Japan

Keiichi Kaneto	Professor, Kyushu Institute of Technology
Madoka Tokumoto	Dr, Advanced Industrial Science and Technology
Mitsumasa Iwamoto	Professor, Tokyo Institute of Technology
Kazuyoshi Tanaka	Professor, Kyoto University
Mitsuyoshi Onoda	Professor, Hyogo University
Shuji Hayase	Professor, Kyushu Institute of Technology
Tetsuya Haruyama	Professor, Kyushu Institute of Technology

From India

Murali Sastry NA	Scientist F, National Chemical Laboratory
K.N. Ganesh	Scientist G, National Chemical Laboratory
B.D. Malhotra	Scientist F, National Chemical Laboratory, New Delhi
B.Raghvendra Prasad	Professor, Indian Institute of Astrophysics
G.V. Shivshankar	Professor, National Center for Biological Science
A.Q. Contractor	Professor, Indian Institute of Technology, Mumbai
R.D. Subramanian	Professor, Indian Institute of Science, Bangalore
S. A. Katter	Professor, Raman Research Institute
Rajiv. Sharma	Director, Indian Government, Department of Science and Technology

3. Visiting Scientists for Information Exchange

Japan to India

Name & Affiliation	Research Subject	Main Host Researcher	Period
Prof. Mitsumasa Iwamoto, Professor, Tokyo Institute of Technology, Graduate School	Advanced Materials, including Polymers and Nanomaterials	Dr.P. Rama Rao, Vice Chancellor, University of Hyderabad	2001/12/9~ 2001/12/17 (9 days)
Prof. Mitsuyoshi Onoda, Professor, Himeji Institute of Technology, Graduate School of Engineering	Advanced Materials, including Polymers and Nanomaterials	Dr.P. Rama Rao, Vice Chancellor, University of Hyderabad	2001/12/9~ 2001/12/17 (9 days)
Prof. Keiichi Kondo, Professor, Kyushu Institute of Technology, Graduate School of Life Science and Systems Engineering	Advanced Materials, including Polymers and Nanomaterials	Dr.P. Rama Rao, Vice Chancellor, University of Hyderabad	2001/12/9~ 2001/12/17 (9 days)
Prof. Tamio Endo, Associate Professor, Mie University	Advanced Materials, including Polymers and Nanomaterials	Dr.P. Rama Rao, Vice Chancellor, University of Hyderabad	2001/12/11~ 2001/12/28 (18 days)

India to Japan

Name & Affiliation	Research Subject	Main Host Researcher	Period
Prof. S. Tantry Research Associate, National Aerospace Laboratories	Advanced Materials, including Polymers and Nanomaterials	Prof. Toyohiko Yano, Associate Professor, Tokyo Institute of Technology	2001/7/1~ 2001/8/12 (43 days)