

**1. Molecular Structure, Dynamics, and Molecular Materials,
Including Supramolecular Science**

Japanese Coordinator:

Prof. Keitaro Yoshihara
Fellow
Toyota Physical & Chemical
Research Institute

Indian Coordinator:

Prof. Kankan Bhattacharya
Professor
Indian Association for the
Cultivation of Science, Kolkata

Molecular Structure, Dynamics, and Molecular Materials,
including Supramolecular Science

【 Coordinators 】

Japanese Coordinator	Indian Coordinator
Prof. Keitaro Yoshihara Fellow Toyota Physical & Chemical Research Institute	Prof. Kankan Bhattacharya Professor Indian Association for the Cultivation of Science

Overviews and Future Plan

【FY2002-2003 Overview】

Research activities under a single non-specified research area were concluded in 2002. Since 2001 new individual research groups with a specific theme have been created (*vide infra*) and they are coming to the second year in 2004. All of research groups are successful in exchange of persons and research activities.

【FY2004-2005 Future Plan】

The continuing research groups are (1)“Femtosecond NIR Spectroscopic Studies of Exciplexes, Excimers, and Conducting Organic Systems” by Prof. K. Iwata (Univ. of Tokyo) and Prof. S. Umopathy (IIS), (2)“Electric and Nonlinear Optical Properties of Organic Thin Films” by Prof. J. Kawamata (Yamaguchi Univ.) and Prof. T. P. Radhakrishnum (Univ. of Hyderabad), (3)“Development of Novel Butadiene Based Photoresponsive Liquid Crystals” by Dr. N. Tamaoki (NIAIST) and Dr. S. Das (CSIR) and (4)“Dynamical Behavior of Molecules Confined in a Reverse Micelles” by Prof. K. Tominaga (Kobe Univ.) and Prof. K. Bhattacharyya (IACS). These groups continue their research, and perhaps some new groups may join the program. The exchange of scientist program is active. The information seminars are held once in each year on two major subfields of materials and spectroscopy.

【Summary】

All the activities are going exceedingly well, producing good results, and scientists of both countries are very enthusiastic. We wish to continue the three programs of group research, exchange of scientists, and seminar.

Implementation Chart of Program

Molecular Structure, Dynamics, and Molecular Materials, including Supramolecular Science

FY	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Research Project		1. Electron Transfer Reactions, Molecular Dynamics J: 1m/61md	J: 2m/43md	J: 1m/12md E: 1m/40md								
				2. Magnetic Properties of Materials based on Novel Graphite Intercalation Compounds J: 1m/7md E: 1md/26md								
					3. Molecular Structure, Dynamics, and Molecular Materials, including Supramolecular Science J: 3m/45md E: 5m/212md	J: 4m/46md E: 2m/73md		J: 1m/10md E: 1m/62md	J: 1m/15md E: 3m/140md	J: 2m/15md E: 4m/127md		
										4. Dynamical Behavior of Molecules Confined in Reverse Micells J: 1m/7md	E: 1m/43md	
											5. Femtosecond NIR Spectroscopic Studies of Exciplexes, Excimers, and Conducting Organic Systems J: 7m/66md E: 5m/178md	
											6. Electronic and Nonlinear Optical Properties of Organic Thin Films J: 1m/8md E: 1m/30md	
											7. Developments of Novel Butadiene Based Photoresponsive Liquid Crystals J: 1m/7md E: 1m/62md	
Seminar			1. Information Exchange Seminar for Molecular structure, Spectroscopy and Dynamics, Oct 21-22, Hayama			2. India-Japan Workshop on Carbon Science, Jan 19-21, Bangalore J: 5m/40md		3. Structure and Dynamics of Chemical and Biological System Jan 12-13, Bangalore J: 5m/20md			4. Japan-India Meeting on Molecular and Spramolecular Materials from Chemistry, Physics and Materials Science Aspects Mar 14-16, Tokyo J: 10m/30md E: 6m/60md	
											5. Structure and Dynamics of Complex Molecular Systems: From a Molecule to a Living Cell, Jan 28-29, Tokyo J: 11m/23md E: 6m/30md	
											6. 2nd Japan-India Meeting on Molecular and Spramolecular Materials, Mar 17-22, Bangalore J: 6m/39md	
Visiting Scientists	J: 2m/17md E: 1m/29md	J: 1m/9md E: 4m/306md	E: 2m/76md	J: 2m/19md E: 2m/46md						E: 1m/11md	J: 1m/11md	
Total	J: 2m/17md E: 1m/29md	J: 1m/9md E: 5m/367	J: 2m/43md E: 2m/76md	J: 4m/38md E: 4m/112md	J: 8m/85md E: 5m/40md	J: 4m/46md E: 2m/73md		J: 6m/30md E: 1m/62md	J: 11m/35md E: 10m/211md	J: 14m/45md E: 11m/164md	J: 16m/131md E: 8m/313md	

Report

1. Joint Research Projects

1-1 Project 3			
Title		Molecular Structure, Dynamics, and Molecular Materials, including Supramolecular Science	
Principal Investigator	Japan	Prof. Keitaro Yoshihara, Fellow Toyota Physical & Chemical Research Institute	
	India	Prof. C. N. R. Rao, President, Jawaharlal Nehru Center for Advanced Scientific Research	
Period		From 1 April 1997 to 31 March 2003	
No. of Exchange	FY2001	Japan to India 1m/ 5md	India to Japan 4m/148md
	FY2002	J to I 1m/8md	I to J 4m/127md
	FY2003	J to I 0m/0md	I to J 0m/0md
Objectives: To understand the role of vibrational relaxation and solvent dynamics on chemical and biological electron transfer reactions. Professor Yoshihara and his group at IMS is studying the experimental aspect while Prof Bagchi's group at IISc., Bangalore is studying the experimental aspects of the same reactions. The objective is to bring the two endeavors together.			
Accomplishment Status : Because of fruitful exchange of information between Prof. Bagchi's group and that of Prof. Yoshihara's, a detailed theory of electron transfer reactions to explain partly the experimental results of Prof Yoshihara has been developed. Several papers have been published in the international journals. Success of this work can be judged by the invitations received to write Invited Articles in the Special Issues of the prestigious journals like Advances of Chemical Physics in electron transfer reactions. Prof Yoshihara also used the results from Indian group to explain his results. Trials are on to extend the theory in order to understand in details the role of the high frequency vibrational modes which are believed to play an important role in the electron transfer reactions in complex systems. This work is in progress u collaboration with Professor Tanimura and Dr Tominaga of IMS, Japan.			

1-2 Project 4			
Title		Dynamical Behavior of Molecules Confined in a Reverse Micelles	
Principal Investigator	Japan	Prof. Keisuke Tominaga, Professor, Molecular Photoscience Research Center, Kobe University	
	India	Prof. Kankan Bhattacharyya, Professor, Department of Physical chemistry, Indian Association for the Cultivation of Science	
Period		From 1 January 2002 to 31 March 2004	
No. of Exchange	FY2001	Japan to India 0m/0md	India to Japan 0m/0md
	FY2002	J to I 1m/7md	I to J 0m/0md
	FY2003	J to I 0m/0md	I to J 1m/43md
<p>Objectives : In this collaboration research program Bhattacharyya and Tominaga are combining characteristic features of the two researchers; knowledge and experience of Bhattacharyya on the studies of reverse micelles and experimental and theoretical techniques of Tominaga on the femtosecond laser spectroscopy. The combination of the two features will bring new aspects on the dynamical studies of reverse micelles.</p> <p>Accomplishment Status : We have done excitation wavelength dependence on solvation dynamics and fluorescence rotational anisotropy in the water pool of the reverse micelle and vesicle. From this experiment we obtained information on the microscopic environment around the dye molecules in the confinement system. One paper has been published and one paper is now submitted for publication. "Excitation Wavelength Dependence of Solvation Dynamics in a Water Pool of a Reverse Micelle", T. Satoh, H. Okuno, K. Tominaga, and K. Bhattacharyya, <i>Chem. Lett.</i> 33 (No. 9), 1090-1091 (2004). "Excitation Wavelength Dependence of Solvation Dynamics of Coumarin 480 in Dimyristoyl-phosphatidylcholine Vesicle", P. Sen, T. Satoh, K. Bhattacharyya, and K. Tominaga, <i>J. Phys. Chem. B</i>, submitted.</p> <p>Future Plan : We will develop the research to deepen our understanding on the dynamics in the reverse micelles by doing the following experiments. Infrared nonlinear spectroscopy on a solute molecule confined in a water pool of a reverse micelle. From this experiment we can obtain information on dynamical behavior of a molecule confined in a reverse micelle, especially on fluctuation of the vibrational transition frequency, population relaxation, rotational relaxation of the dye molecule. Time-resolved infrared spectroscopy on a solute molecule in hydrogen bonding solvents. From this experiment we can obtain information on dynamical behavior of a molecule in a hydrogen-bonding solvent.</p>			

1-3 Project 5			
Title		Femtosecond Near-infrared Spectroscopic Studies on Charge Carrier Dynamics, Exciplex Dynamics and Organic Pigments	
Principal Investigator	Japan	Prof. Koichi Iwata, Associate Professor, University of Tokyo	
	India	Prof. Siva Umaphathy, Professor, Indian Institute of Science	
Period		From 1 April 2003 to 31 March 2006	
No. of Exchange	FY2001	Japan to India 0m/0md	India to Japan 0m/0md
	FY2002	J to I 0m/0md	I to J 0m/0md
	FY2003	J to I 4m/44md	I to J 2m/42md
	FY2004	J to I	I to J
Objectives :			
<p>When a new chemical bond is formed in the course of a chemical reaction, electrons have to be relocated from their original positions. The electrons less strongly bond to the nuclei, or “loose electrons”, thus play an essential role in the chemical reactions. In this project, we investigate the dynamics of the loose electrons associated with intra- and inter-molecular electron transfer processes or excited delocalized states of C=C conjugated systems, by using femtosecond time-resolved near-infrared spectroscopy covering the spectral range of 0.9 to 1.5 μm. Because many loose electrons show characteristic absorption bands in this spectral region and because most of the ground state molecules do not show strong electronic transitions here, this spectroscopy serves as a sensitive method for tracing the loose electrons.</p>			
Accomplishment Status :			
<p>In FY2003, the Indian investigators synthesized various molecules including symmetrically and asymmetrically substituted 9,9'-bianthryl. They visited Japan and measured the femtosecond time-resolved near-infrared spectra for monitoring the electron transfer processes of these molecules. We find a clear difference between the charge transfer states of the symmetrically substituted bianthryl derivatives and the asymmetrically substituted derivatives. The result was presented at Bunshi Kozo Sogo Toronkai in September, 2004.</p>			
<p>In February 2004, the Japanese investigators including three graduate students visited Bangalore. On this occasion, we organized a student meeting named “Indo-Japan Student Symposium”. In the symposium, three Japanese graduate students and four Indian graduate students had 45 minute oral presentations. The students from the both sides looked quite excited on experiencing different cultures and were eager to build new friendship. Exchange of graduate students helps developing the mutual understanding and personal sympathy among them, which of course is quite important for the future of the two scientific communities.</p>			
Future Plan :			
<p>In FY2004, the Indian investigators plan to visit Tokyo, for investigating the loose electron dynamics with the femtosecond time-resolved near-infrared spectroscopy. The Japanese investigators will visit India, for discussing the results of the experiments in Tokyo. We also plan to organize the second student symposium in India. We believe this educational activity is also suited for the aim of the entire exchange program.</p>			

1-4 Project 6			
Title		Electronic and Nonlinear Optical Properties of Organic Thin Films	
Principal Investigator	Japan	Prof. Jun Kawamata, Associate Professor, Yamaguchi University	
	India	Prof. Radhakrishnan Thavarool Puthiyedath, Professor, University of Hyderabad	
Period		From 1 April 2003 to 31 March 2005	
No. of Exchange	FY2001	Japan to India 0m/ 0md	India to Japan 0m/0md
	FY2002	J to I 0m/0md	I to J 0m/0md
	FY2003	J to I 1m/8md	I to J 1m/30md
	FY2004	J to I	I to J
<p>Objectives :</p> <p>One of the key challenges in the area of organized molecular assembly is the realization of strong quadratic nonlinear optical (NLO) effects in bulk structures by maximal exploitation of the large molecular responses. Several strategies have been developed for the fabrication of noncentrosymmetric molecular crystals with optimal supramolecular organization to achieve efficient quadratic NLO responses such as strong second harmonic generation (SHG). We have also demonstrated simple means for stabilizing monolayers of ionic amphiphiles which otherwise are highly unstable at the air-water interface. These are based on the complexation of the amphiphiles with a polyelectrolyte introduced in the subphase. We discovered that the introduction of polyelectrolytes in the aqueous subphase is a simple strategy for achieving efficient deaggregation of ionic molecules at the air-water interface. We have also demonstrated that this deaggregation can be profitably exploited for the enhancement of the NLO response from the Langmuir-Blodgett (LB) films.</p> <p>The rearrangement behavior of molecules in an LB film is a topic of fundamental relevance in LB studies. Some of the LB films are known to realign within a few hours after fabrication. It is expected that the rearrangement behavior can be arrested by our polyelectrolyte based strategy. Hence, in this period, we have attempted some preliminary studies to compare the rearrangement behavior between a conventional LB film and the polyelectrolyte stabilized ones. Based on the results, we aim at fabricating a stable film with salient electronic and NLO response.</p> <p>Accomplishment Status :</p> <p>We have confirmed that the SHG from LB films of the cationic hemicyanine dye is considerably enhanced when the films are fabricated with polyanions in the subphase, as a result of deaggregation of the NLO-phores. We reported the results as two papers.</p> <ol style="list-style-type: none"> 1. "Polyelectrolyte Assisted Deaggregation and SHG Enhancement in Hemicyanine Langmuir-Blodgett Film", M. S. Chandra, Y. Ogata, J. Kawamata, T. P. Radhakrishnan, <i>Langmuir</i>, 19(2003)10124-10127. 2. "Enhanced SHG in Polyelectrolyte Complexed Hemicyanine Dye Langmuir-Blodgett Films" M. Sharath Chandra, Y. Ogata, J. Kawamata and T. P. Radhakrishnan, <i>J. Nonlinear Optical Phys. and Mater.</i>, (2004) in press. <p>A fundamental problem associated with the LB technique is that, once the molecular assembly obtained through mechanical compression of Langmuir films at the air-water interface is transferred to a solid substrate as LB film, it is no longer necessarily in a thermodynamically stable state. The LB film can undergo molecular level reorganizations with or without external stimuli, which can impair its potential functionality. We have found that the laser irradiation involved in the SHG process itself perturbs the molecular assembly in the film with detrimental consequences for its SHG capability in the case of the cationic hemicyanine LB film. We have shown that the polyelectrolyte methodology is an effective strategy to arrest the SHG degradation in the film. The results of these studies have recently been communicated.</p>			

- “Ultrathin Films of Hemicyanine Amphiphile: Polyelectrolyte Templating Arrests the Decay of Second Harmonic Generation”, M. Sharath Chandra, M. Ghanashyam Krishna, H. Mimata, J. Kawamata, T. Nakamura and T. P. Radhakrishnan, *submitted to Angew. Chem.*

Future Plan :

The method of polyelectrolyte-templating is of considerable practical interest in the fabrication of monolayer based molecular devices. We are now attempting to develop novel films having a wide variety of physical properties using the method. In order to develop such devices, much more investigation of the deaggregation and rearrangement behaviors is still needed. As described above, we have demonstrated the effectiveness of the polyelectrolyte stabilized LB film qualitatively. However, quantitative understandings of the film formation mechanism, novel phenomena observed for the film and so forth, are not demonstrated adequately yet. We are planning further studies especially at the molecular level, expanding the collaborative efforts.

1-5 Project 7			
Title		Development of Novel Butadiene Based Photoresponsive Liquid Crystals	
Principal Investigator	Japan	Prof. Nobuyuki Tamaoki, Group Leader, Institute for Materials and Chemical Process, National Institute of Advanced Industrial Science and Technology	
	India	Prof. Suresh Das, Scientist E & Head, Photosciences and Photonics Division, Regional Research Laboratory, Council of Scientific and Industrial Research	
Period		From 1 April 2003 to 31 March 2006	
No. of Exchange	FY2001	Japan to India 0m/ 0md	India to Japan 0m/0md
	FY2002	J to I 0m/0md	I to J 0m/0md
	FY2003	J to I 1m/7md	I to J 1m/62md
<p>Objectives :</p> <p>(i) Synthesis and characterization of novel butadiene based photoresponsive liquid crystals</p> <p>(ii) To explore the use of these photoresponsive liquid crystals in imaging devices</p> <p>Accomplishment Status :</p> <p>1-(Alkoxyphenyl)-4-(cyanophenyl)buta-1<i>E</i>,3<i>E</i>-dienes have been used as novel photoresponsive dopants for investigating light induced changes in the pitch of a glass-forming cholesteric liquid crystal, dicholesteryl-10,12-docosadienedioate. X-ray diffraction studies have helped to establish the role of microscopic changes of smectic domains within the helical superstructure, induced by the dopant molecules and their photoisomers, which result in changes in their macroscopic light reflecting properties. Increasing concentration (1-12 wt%) of these dopants causes a dramatic red-shift in the wavelength of reflected light by the host CLC, extending it into the near-infrared region. The extent of red-shift depends strongly on the molecular length of the dopants and those possessing lengths between 25-28 Å exhibit the maximum shift ($\Delta\lambda_{\max} = 435$ nm). Photoisomerization of these dopants leads to a blue-shift of the reflected light and this effect could be used to tune the light reflectivity of these mixtures over a large part of the visible region. The cholesteric pitch and hence the reflected light by these materials could be fixed in a glassy state by rapid cooling them from their cholesteric temperatures to 0 °C. The efficacy of these materials for full-color photoimaging has also been demonstrated.</p> <p>Future Plan :</p> <p>We plan to synthesize butadiene linked cholesteryl derivatives and study of photoeffects in the cholesterol dimesogens.</p>			

Exchange Visits Undertaken

Japan to India

No. of Project	Name & Affiliation	Research Subject	Main Host Researcher	Period
Project 3 (FY2001)	Prof. Hiroo Hamaguchi Professor, University of Tokyo	Excited State Structure and Relaxation Pathway in EDA Molecules by Time-Resolved Infrared/Raman Spectroscopic Measurements	Prof. Anunay Samanta, Professor, University of Hyderabad	2001/8/4~ 2001/8/8 (5 days)
Project 3 (FY2002)	Prof. Toshiaki Enoki Professor, Tokyo Institute of Technology	Electronic and Magnetic Properties of Nano-Graphic, Disordered Carbons, and Organic Charge Transfer Complex-Based Molecular Magnets	Prof. V.Subramanyan	2003/3/6~ 2003/3/13 (8 days)
Project 4 (FY2002)	Prof. Keisuke Tominaga Professor, Kobe University	Dynamical Behavior of Molecules Confined in a Reverse Micelles	Prof. Kankan Bhattacharyya, Professor, Department of Physical chemistry, Indian Association for the Cultivation of Science	2002/12/14~ 2002/12/20 (7days)
Project 4 (FY2003)	Prof. Keisuke Tominaga Professor, Kobe University	Dynamical Behavior of Molecules Confined in a Reverse Micelles	Prof. Kankan Bhattacharyya, Professor, Department of Physical chemistry, Indian Association for the Cultivation of Science	2004/12/14~ 2004/12/20 (7days)
Project 5 (FY2003)	Prof. Kouichi Iwata Associate Professor, University of Tokyo	Femtosecond Near-infrared Spectroscopic Studies on Charge Carrier Dynamics, Exciplex Dynamics and Organic Pigments	Prof. S. Umamathy, Professor, Indian Institute of Science	2004/1/7~ 2004/1/17 (11days)
Project 5 (FY2003)	Mr Tomohisa Takaya PhD student, University of Tokyo	Femtosecond Near-infrared Spectroscopic Studies on Charge Carrier Dynamics, Exciplex Dynamics and Organic	Prof. S. Umamathy, Professor, Indian Institute of Science	2004/1/7~ 2004/1/17 (11days)

		Pigments		
Project 5 (FY2003)	Mr Shinsuke Fujisige PhD student, University of Tokyo	Femtosecond Near-infrared Spectroscopic Studies on Charge Carrier Dynamics, Exciplex Dynamics and Organic Pigments	Prof. S. Umapathy, Professor, Indian Institute of Science	2004/1/7~ 2004/1/17 (11days)
Project 5 (FY2003)	Mr Ken Hayashi PhD student, University of Tokyo	Femtosecond Near-infrared Spectroscopic Studies on Charge Carrier Dynamics, Exciplex Dynamics and Organic Pigments	Prof. S. Umapathy, Professor, Indian Institute of Science	2004/1/7~ 2004/1/17 (11days)
Project 6 (FY2003)	Prof. Jun Kawamata Associate Professor, Yamaguchi University	Electronic and Nonlinear Optical Properties of Organic Thin Films	Prof. T. P. Radhakris	2004/3/14~ 2004/3/21 (8 days)
Project 7 (FY2003)	Prof. Nobuyuki Tamaoki Group Leader, Institute for Materials and Chemical Process, National Institute of Advanced Industrial Science and Technology	Development of Novel Butadiene Based Photoresponsive Liquid Crystals	Prof. Suresh Das, Scientist E & Head, Photosciences and Photonics Division, Regional Research Laboratory, Council of Scientific and Industrial Research	2004/1/3~ 2004/1/9 (7days)

India to Japan

No. of Project	Name & Affiliation	Research Subject	Main Host Researcher	Period
Project3 (FY2001)	Prof. Anunay Samanta Professor, University of Hyderabad	Excited State Structure and Relaxation Pathway in EDA Molecules by Time-Resolved Infrared/Raman Spectroscopic Measurements	Prof. Hiroo Hamaguchi, Professor, University of Tokyo	2001/6/2~ 2001/7/25 (54days)
Project 3 (FY2001)	Prof. Vishnubhotla Prasad	Amorphous Carbon Films and	Prof. Toshiaki Enoki, Professor, Tokyo	2002/1/16~ 2002/2/15

	Dr., Indian Institute of Science	high Temperature Superconductors	Institute of Technology	(31 days)
Project 3 (FY2001)	Prof. Dipak Kumar Palit Doctor, Bhabah Atomic Research Centre		Prof. Keitaro Yoshihara Professor JAIST	2002/2/3~ 2002/3/29 (55 days)
Project 3 (FY2002)	Prof. Govinda Raj Doctor, Indian Institute of Science, Bangalore	Synthesis of Zeolite Materials and Their Application to the Catalytic Reactors	Prof. Tatsuya Ohkubo, Associate Professor, University of Tokyo	2002/10/21~ 2002/12/6 (47days)
Project 3 (FY2002)	Prof. Anunay Samanta Professor, University of Hyderabad	Structure and Dynamics of EDA Complexes by Time-Resolved infrared and Raman Spectroscopy	Prof. Hiroo Hamaguchi, Professor, University of Tokyo	2002/5/9~ 2002/5/30 (22 days)
Project 3 (FY2002)	Prof. Indranil Rudra PhD Student, Indian Institute of Science, Bangalore	Quantum Dynamics in Nanoscale Molecular Magnets	Prof. Seiji Miyashita Associate Professor University of Tokyo	2002/7/20~ 2003/8/31 (43 days)
Project 6 (FY2002)	Prof. T. P. Radhakrishnan Associate Professor, University of Hyderabad	Electronic and Nonlinear Optical Properties of Organic Thin Films	Prof. Takayoshi Nakamura Professor Hokkaido University	2003/11/20~ 2003/12/4 (15 days)
Project 4 (FY2003)	Prof. Pratic Sen Junior Research fellow, Indian Association for the Cultivation of Science	Dynamical Behavior of Molecules Confined in a Reverse Micelles	Prof. Keisuke Tominaga, Professor, Kobe University	2004/2/18~ 2004/3/31 (43 days)
Project 5 (FY2003)	Prof. S.Umapathy Professor, Indian Institute of Science	Femtosecond NIR Spectroscopic Studies of Exciplexes, Excimers and Conducting Organic Systems	Prof. Kouichi Iwata, Associate Professor, University of Tokyo	2003/12/2~ 2003/12/22 (21 days)

Project 5 (FY2003)	Prof. A.Samantha Professor, University of Hyderabad	Femtosecond NIR Spectroscopic Studies of Exciplexes, Excimers and Conducting Organic Systems	Prof. Kouichi Iwata, Associate Professor, University of Tokyo	2003/12/2~ 2003/12/22 (21 days)
Project 6 (FY2003)	Prof. M.Sharath Chandra PhD Student, Senior Research Fellow, University of Hyderabad	Electronic and Nonlinear Optical Properties of Organic Thin Films	Prof. Jun Kawamata, Associate Professor, Yamaguchi University	2003/11/8 ~ 2003/12/7 (30 days)
Project 7 (FY2003)	Prof. Riju Davis Senior Research fellow, Regional Research Institute, Trivandrum	Development of Novel Butadiene Based Photoresponsive Liquid Crystals	Prof. Nobuyuki Tamaoki, Group Leader, Institute for Materials and Chemical Process, National Institute of Advanced Industrial Science and Technology	2003/7/1~ 2003/8/31 (62 days)

2. Seminars

2-1 Seminar 4	
Title	Japan-India Meeting on Molecular and Supramolecular Materials from Chemistry, Physics and Materials Science Aspects
Japanese Organizer	Prof. Toshiaki Enoki, Professor, Department of Chemistry, Graduate School of Science and Engineering Tokyo Institute of Technology
Indian Organizer	Prof. C. N. R. Rao, President, Jawaharlal Nehru Centre for Advanced Scientific Research
Period & Place	From 14 March, 2002 to 16 March, 2002 Tokyo
<p>Objectives : Scientific exchange on molecular materials between Japan and India has been growing very rapidly in the past five years, on the basis of active personnel exchanges and collaborations. In 1998, India-Japan Meeting on Carbon was held in Bangalore, India, which was chaired by Prof. C. N. R. Rao. In this meeting, six Japanese delegates participated and discussed on carbon-based materials, fullerenes, carbon-nanotubes, etc. In the meantime, the research activities of molecular materials science have been growing as one of the important issues from point of nanoscience and nanotechnology, and have produced important breakthroughs. Japanese and Indian researchers have strongly contributed to the development of the field of molecular materials science. The proposed meeting aims at stimulating bilateral exchanges between researchers in both countries, who play leading roles in the molecular materials science field, and searching new frontier in the field</p>	
<p>Accomplishment Status : Seven Indian and eleven Japanese delegates participated in the meeting, who are leading the field of science of molecular and supramolecular materials in both countries. In the meeting, where each delegate gave 30 min lecture, discussion has been focused on inorganic open-framework structures, nanocarbons such as fullerenes, carbon nanotubes and nanographite, supramolecule design, nanostructure materials, self-assembled molecular systems, multifunctional materials, thin layers, multilayered systems, organic LED, nonlinear optical materials, photo-induced electron transport, molecular magnets with photo-functionality, single molecule magnets, molecular magnetic conductors, molecular electronics, etc. In the two day meeting, intensive discussion and exchanging ideas have been made intensively between the researchers working in different fields. Although the discussion between researchers having different backgrounds; physical chemistry, solid state physics, solid state chemistry, coordination chemistry, materials science, was sometimes pointless, it could prove the necessity of multi-aspects in understanding scientific issues. The discussion was very productive and future promising. It clarified the necessity of making continuous personnel exchanges and collaborations between the two countries.</p>	
<p>Program : March 14(Thu) 19:00 dinner</p> <p>March 15(Fri) 9:00-9:10 T. Enoki Opening address 9:10-9:45 C. N. R. Rao New Insights into Inorganic Open-Framework Structures 9:45-10:20 S. Iijima Recent Progress in the Work on Carbon Nanotubes</p> <p>Coffee Break</p>	

10:40-11:15	S. Miyashita Single Molecule Magnet (theory)
11:15-11:50	K. Hashimoto Molecular magnets with photo-functionality
11:50-12:25	S. Ramasesha Electron-Hole Recombination Dynamics in Organic LED Materials
14:20-14:55	R. Saito Raman Spectroscopy of Single Carbon Nanotube
14:55-15:30	T. Enoki Electronic Properties of Nano-graphite
Coffee Break	
15:50-16:25	M. K. Sanyal X-ray Scattering Studies of Nanometer Sized Thin Films and Multilayers
16:25-17:00	M. Hara Phase Transition of Self-Assembled Monolayers
17:00-17:35	T. P. Radhakrishnan Molecular Materials for SHG and Electro-Optics-Design of Optimal Supramolecular Structures
17:35-18:10	S. Bhattacharya Molecular Modulation of Materials Properties Using Surfactant Assemblies
19:00-21:00	banquette
March 16(Sat)	
9:00-9:35	K. S. Narayan Photo-Induced Transport in Organic Solids
9:35-10:10	T. Nakamura Assembly of Molecular Conductors and Magnets towards Molecular Electronics
Coffee Break	
10:30-11:05	M. Sastry Assembly of Nanoscale Structures Using Weak Interactions
11:05-11:40	M. Fujita Self-Assembled Molecular Systems
11:40-11:50	Prof. C. N. R. Rao Closing address
List of Participants :	
From Japan	
Saburo Nagakura	Chairman, Kanagawa Academy of Science and Technology
Keitaro Yoshihara	Vice President, Japan Advanced Institute of Science and Technology, Hokuriku
Toshiaki Enoki	Professor, Graduate School of Science and Engineering, Tokyo Institute of Technology
Sumio Iijima	Professor, Faculty of Science and Technology, Meijo University
Masahiko Hara	Team Leader, Frontier Research System, The Institute of Physical and Chemical Research (RIKEN)
Takayoshi Nakamura	Professor, Research Institute for Electronic Science, Hokkaido University
Makoto Fujita	Professor, Graduate School of Engineering, Nagoya University

Seiji Miyashita	Professor, Graduate School of Engineering, University of Tokyo
Kazuhito Hashimoto	Professor, Research Center for Advanced Science and Technology, University of Tokyo
Riichiro Saito	Associate Professor, Faculty of Electro-Communication, University of Electro-Communication
From India	
C.N.R. Rao	President, Jawaharlal Nehru Centre for Advanced Scientific Research
S.Ramasesha	Professor, Solid State and Structural Chemistry Unit, Indian Institute of Science
S.Bhattacharya	Associate Professor, Department of Organic Chemistry, Indian Institute of Science
K.S.Narayan	Associate Professor, Materials Unit, Jawaharlal Nehru Centre for Advanced Scientific Research
M.K.Sanyal	Head, Surface Physics Division, Saha Institute of Nuclear Physics
M.Sastry	Scientist E-1, Materials Chemistry Division, National Chemical Laboratory
T.P. Radhakrishnan	Associate Professor, School of Chemistry, University of Hyderabad

2-2 Seminar 5	
Title	Structure and Dynamics of Complex Molecular System: From a Molecule to a Living Cell
Japanese Organizer	Prof. Hiroo Hamaguchi, Professor, Department of Chemistry
Indian Organizer	Prof. Biman Bagchi, Professor, Indian Institute of Science, Bangalore
Period & Place	From 28 January, 2003 to 29 January, 2003 Tokyo
<p>Objectives : To gather selected leading researchers of physical chemistry from the two countries, both senior and junior, and experimentalists and theoreticians, and provides ideal environment and atmosphere for discussing the hot issued on the structure and dynamics of complex molecular systems, form a molecule to a living cell.</p> <p>Accomplishment Status : An agreement has been reached, based on fruitful academic exchanges accomplished during the symposium, that next meeting will be held in Calcutta in the year 2004 that the continuous sponsorship of JSPS and DST will be enthusiastically requested.</p>	
<p>Program :</p> <p>28 January</p> <p>10:00-10:15-Opening Address</p> <p>10:15-11:45-2lectures</p> <p>11:45-13:00-Lunch</p> <p>13:00-15:15-3lectures</p> <p>15:15-15:45-Break</p> <p>15:45-18:00-3lectures</p> <p>18:15-20:00-Reception</p> <p>29 January</p> <p>10:00-12:15-3lectures</p> <p>12:15-13:15-Lunch</p> <p>13:15-14:45-2lectures</p> <p>14:45-15:15-Break</p> <p>15:15-16:45-2lectures</p> <p>16:45-17:00-Closing Address</p> <p>18:00~Dinner</p>	

List of Participants :

From Japan

Saburo Nagakura	Chairman, Kanagawa Academy of Science and technology
Keitaro Yoshihara	Vice President, Japan Advanced Institute of Science and Technology, Hokuriku
Hiroo Hamaguchi	Professor, University of Tokyo
Iwao Omine	Professor, Institute for Molecular Science, Okazaki National Research Institutes
Keisuke Tominaga	Professor, Kobe University
Masahide Terajima	Professor, Kyoto University
Tahei Tahara	Team Leader, Molecular Spectroscopy Laboratory, The Institute of Physical and Chemical Research (RIKEN)
Tatsuo Arai	Professor, University of Tsukuba
Takashi Ogura	Associate Professor, University of Tokyo
Koichi Iwata	Associate Professor, University of Tokyo
Satyen Shaha	Doctor, University of Tokyo
S. Watgaonkar	Doctor, Tohoku University

From India

B. Bagchi	Professor, Indian Institute of Science, Bangalore
S. Umapathy	Professor, Indian Institute of Science, Bangalore
A. Samanta	Professor, University of Hyderabad
D. Palit	Bhaba Atomic Research Centre
N. Periasamy	Professor, Tata Institute of Fundamental Research
K.Bhattacharyya	Professor, Department of Physical Chemistry, Indian Association for the Cultivation of Science

2-3 Seminar 6	
Title	2 nd Japan-India Meeting on Molecular and Supramolecular Materials from Chemistry, Physics and Materials Science Aspects
Japanese Organizer	Prof. Toshiaki Enoki, Professor, Department of Chemistry, Graduate School of Science and Engineering Tokyo Institute of Technology
Indian Organizer	Prof. C. N. R. Rao, President, Jawaharlal Nehru Center for Advanced Scientific Research
Period & Place	From 17 March, 2004 to 22 March, 2004 Bangalore
<p>Objectives :</p> <p>Scientific exchange on molecular materials between Japan and India has been stimulated by the past two meetings; Meeting on Carbon, January, 1998, Bangalore and Japan-India Meeting on Molecular and Supramolecular Materials from Chemistry, Physics and Materials Science Aspects, March, 2002, Tokyo. On the basis of the discussion in the meetings, many personnel exchanges and collaborations have been produced, which have contributed to developing activities in molecular materials science. Recently, nanoscience and nanotechnology have been a key issue in materials science, in which molecular materials are expected to play an important role. Japanese and Indian researchers have strongly contributed to the development of the field of molecular materials science. The proposed meeting aims at stimulating bilateral exchanges between researchers in both countries, who play leading roles in the molecular materials science field, and searching new frontier in the field.</p>	
<p>Accomplishment Status :</p> <p>Seven Japanese and ten Indian delegates participated in the meeting, who are leading the field of science of molecular and supramolecular materials in both countries. In the meeting, where each delegate gave 45 min lecture, discussion has been focused on organic molecular films, supramolecular assemblies, metal-organic nanostructures, molecular magnets, magnetic nanographite and nanotubes, molecular recognition, electron transport in nanosystems, photonic and electronic functions in metal complexes, organic nanoparticles, nonlinear optical systems, etc. In the two day meeting, intensive discussion and exchange idea have been made intensively between the researchers working in different fields. In this meeting, some of the participants have already collaborated with each other between the two countries, since they have participated in the past meetings and started their collaborations. Therefore, the meeting worked very effectively for enhancing scientific exchange between the two countries. The discussion was very productive and future promising. On the basis of the discussion, many of possible bilateral scientific interactions have been proposed between individual researchers between both countries.</p>	
<p>Program :</p> <p>Friday 19th Mar. 2004</p> <p>08:30 hrs– 09:00 hrs : Registration</p> <p>09:00 hrs – 09:15 hrs : Opening Remarks – Prof. C. N. R. Rao</p> <p>09:15 hrs – 10: 00 hrs : Prof. Toshiaki Enoki Host-guest systems of nano-graphite</p> <p>10:00 hrs – 10: 45 hrs : Prof. K.S.Narayan Optical Control of 3-Terminal Semiconducting Polymer Device Structures</p> <p>10:45 hrs– 11:05 hrs : Coffee Break</p> <p>11:05 hrs – 11:50 hrs : Dr. Swapan Pati Electrical Transport in nano-systems</p> <p>11:50 hrs – 12:30 hrs : Prof. Seiji Miyashita Quantum mechanical magnetization transition</p>	

12:30 hrs– 01:15 hrs :	in nano magnetic molecule Dr. J.V. Yakhmi Nano-scale Magnets: molecular self-assembly
01:15 hrs – 02:15 hrs :	Lunch
02:15 hrs – 03:00 hrs :	Prof. Hiroshi Nishihara Photonic and Electronic Functions of Azo-conjugated Metal Complexes
03:00 hrs – 03.45 hrs :	Prof. Santanu Bhattacharya Supramolecular Aggregates in the formation of Organic Nanoparticles
04:05 hrs – 04:50 hrs :	Prof. T. P. Radhakrishnan Optical and Nonlinear Optical Materials Based on Diaminodicyanoquinodimethanes
04:50 hrs– 05:35 hrs :	Prof. Jun Kawamata Two-photon absorption of organic materials

Saturday Mar. 20 th Sat.	
09:00 hrs – 9:45 hrs :	Prof. A. J. Pal Conductance switching in organic molecules films
09:45 hrs– 10:30 hrs :	Prof. Takayoshi Nakamura Supramolecular assemblies of conductors and magnets
10:30 hrs– 10:50 hrs :	Prof. G. U. Kulkarni Electrical properties of nanostructured metal -organic bilayers
10:50 hrs - 11:35 hrs :	Prof. Kunio Awaga Molecular spins- from organic radicals to nano-magnets
11:35 hrs –12:20 hrs :	Prof. S. Ramasesha Single Molecule Magnets
12:20 hrs - 01:05 hrs :	Prof. Kouichi Kusakabe Theoretical design of magnetic nanographite and magnetic carbon nanotubes.
01:05 hrs – 02:15 hrs :	Lunch
02:15 hrs - 03:00 hrs :	Dr. K. N. Ganesh Molecular recognition based design of DNA/PNA nanomaterials
03:15 hrs - 04:00 hrs :	Prof. Uday Maitra Supramolecular Chemistry of Bile Salt Analogs
04:00 hrs– 04:15 hrs :	Closing
List of Participants :	
From Japan	
Takayoshi Nakamura	Professor, Hokkaido University
Seiji Miyashita	Professor, The University of Tokyo
Hiroshi Nishihara	Professor, The University of Tokyo
Kunio Agawa	Professor, Nagoya University
Kouichi Kusakabe	Associate Professor, Osaka University
Toshiaki Enoki	Profesor, Tokyo Institute of Technology
From India	
Prof. C. N. R. Rao	President, Jawaharlal Nehru Centre for Advanced Scientific Research
Prof. K. S. Narayan	Profesor, Jawaharlal Nehru Centre for Advanced Scientific Research
Dr. Swapan Pati	Jawaharal Nehru Centre for Advanced Scientific Research

Dr. J.V. Yakhmi	Bhabha Atomic Research Centre
Prof. Santanu Bhattacharya	Profesor, Indian Institute of Science
Prof. T. P. Radhakrishnan	Profesor, University of Hyderabad
Prof. A. J. Pal	Profesor, Indian Association for the Cultivation of Science
Prof. G. U. Kulkarni	Profesor, Indian Institute of Science
Prof. S. Ramasesha	Profesor, Indian Institute of Science
Dr. K. N. Ganesh	National Chemical Laboratory
Prof. Uday Maitra	Professor, Indian Institute of Science

2-4 Seminar FY2004	
Title	Frontiers of Molecular Science Developed by Advanced Spectroscopy
Japanese Organizer	Prof. Keisuke Tominaga, Professor, Molecular Photoscience Research Center, Kobe University
Indian Organizer	Prof. Kankan Bhattacharya, Professor, Indian Association for the Cultivation of Science Prof. Biman Bagchi, Professor, Indian Institute of Science, Bangalore
Period & Place	From 3 December, 2004 to 4 December, 2004 Koltaka
<p>Objectives : Researchers in the both countries will get together to exchange recent results and to discuss science in an informal atmosphere. The research filed of this seminar covers the state of the art of the technology including ultrafast spectroscopy, ultra-high resolution spectroscopy, spectroscopy on mass-selected cluster, spectroscopy on biological molecules, and single-molecule spectroscopy.</p>	
<p>Program :</p> <p>December 03, 2004</p> <p>09:40 lecture 10:10 lecture 10:40 lecture 11:30 lecture 12:00 lecture 12:30 lecture 01:00 LUNCH 01:40 lecture 02:10 lecture 03:00 lecture 03:30 lecture 04:00 lecture</p> <p>December 04, 2004</p> <p>09:30 lecture 10:00 lecture</p>	
<p>List of Participants :</p> <p>From Japan</p> <p>Teizo Kitagawa, Professor, Okazaki Institute for Integrative Bioscience Iwao Ohmine, Professor, Nagoya University, Faculty of Science Jun-ya Hasegawa, Research Associate, Kyoto University Kiyokazu Fuke, Professor, Kobe University, Faculty of Science Yoshitaka Tanimura, Professor, Kyoto University, Faculty of Science Keisuke Tominaga, Professor, Kobe University, Molecular Research Center Kazuya Watanbe, Research Associate, Graduate University for Advanced Studies</p>	

From India

R. Varadarajan,	Indian Institute of Science
A. Chandra,	Indian Institute of Technology
G. Krishnamoorthy,	Tata Institute of Fundamental Research
S. K. Ghosh,	Bhabha Atomic Research Centre
K. Bhattacharyya,	Indian Assn for Cultivation of Science
B. L. Tembe,	Indian Institute of Technology
V. Subramanian,	Central Leather Research Institute
K. Watanabe,	Institute for Molecular Science
D. K. Palit,	Bhabha Atomic Research Centre
C. Mukhopadhyay,	Calcutta University
S. Bandyopadhyay,	Indian Institute of Technology
B. Bagchi, Indian	Institute of Science
N. Sathyamurthy,	Indian Institute of Technology
A. Chattopadhyay,	Centre for Cellular and Molecular Biology

3. Visiting Scientists for Information Exchange

Japan to India

Name & Affiliation	Research Subject	Main Host Researcher	Period
Dr. Akira Miyazaki Assistant, Tokyo University	Development of Properties of Nano-graphite and organic magnetic material	Dr. J.V. Yakhim Bhabha Atomic research Centre	2004/2/18~ 2004/2/28 (11 days)

India to Japan

Name & Affiliation	Research Subject	Main Host Researcher	Period
Prof. S. Ramasesha Professor, SSCU, IISc, Bangalore	Quantum dynamics of micro-magnetic particles	Prof. Seiji Miyashita Professor Univ. of Tokyo	2002/11/30~ 2003/12/4 (15 days)
Prof. Kankan Bhattacharyya Professor, IISc, Bangalore	Frontiers of Molecular Science Developed by Advanced Spectroscopy	Prof. Keisuke Tominaga, Professor, Kobe University	2002/1/23~ 2002/2/2 (11 days)