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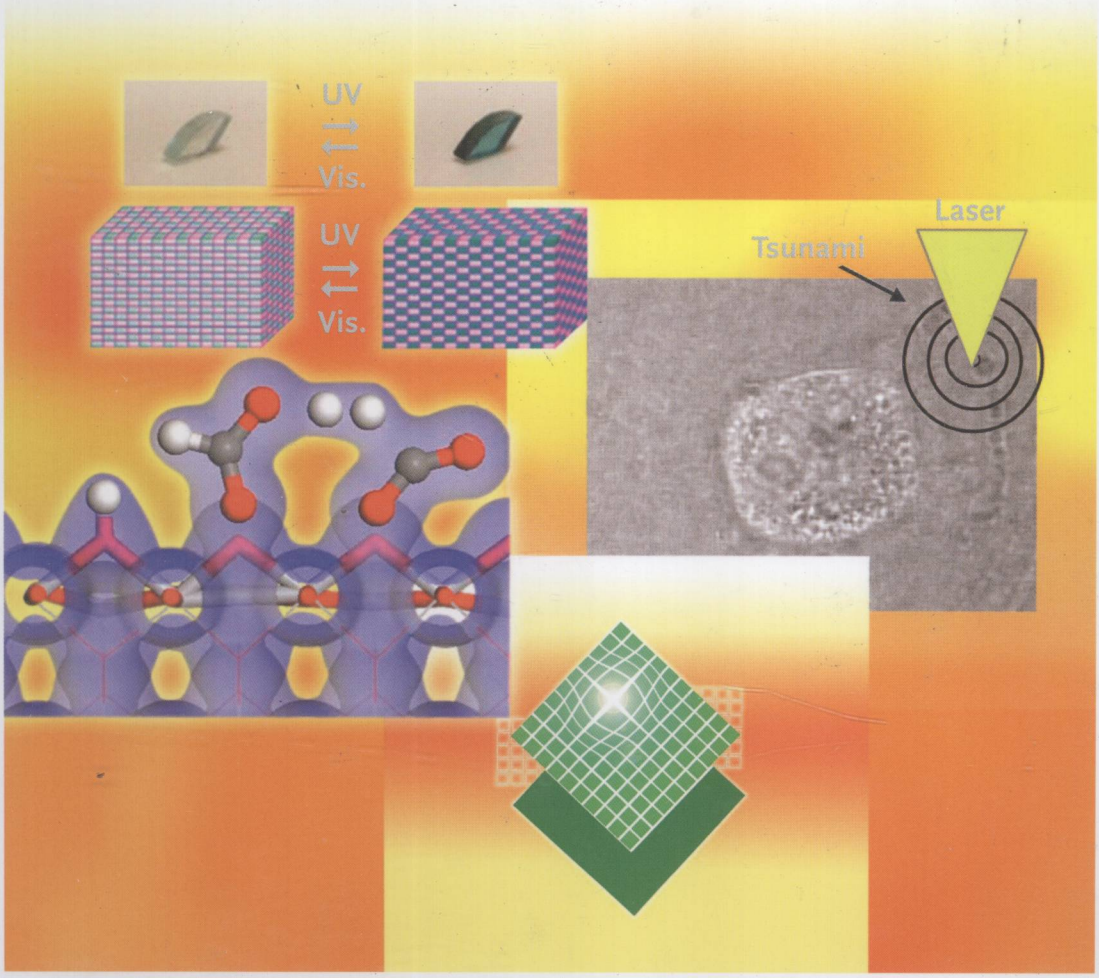
Molecular Nano Dynamics

Volume 1:
Spectroscopic Methods and Nanostructures



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Volume I: Spectroscopic Methods and Nanostructures

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Hiroshi Fukumura, Masahiro Irie, Yasuhiro Iwasawa,
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Preface

Over the past two decades, studies of chemical reaction dynamics have shifted from ideal systems of isolated molecules in the gas phase, of molecular clusters in jet beams, on ultra-clean surfaces, in homogeneous and in dilute molecular solutions, and in bulk crystals, towards nanosystems of supramolecules, colloids, and ultrasmall materials, following the contemporary trends in nanoscience and nanotechnology. The preparation, characterization, and functionalization of supramolecules, molecular assemblies, nanoparticles, nanodots, nanocrystals, nanotubes, nanowires, and so on, have been conducted extensively, and their chemical reactions and dynamic processes are now being elucidated. The systematic investigation of molecular nanosystems gives us a platform from which we can understand the nature of the dynamic behavior and chemical reactions occurring in complex systems such as molecular devices, catalysts, living cells, and so on. Thus we have conducted the KAKENHI (The Grant-in-Aid for Scientific Research) Project on Priority Area "Molecular Nanodynamics" (Project Leader: Hiroshi Masuhara) for the period from 2004 April to 2007 March, involving 86 laboratories in Japan.

For the investigation of such complex systems new methodologies which enable us to analyze dynamics and mechanisms in terms of space and time are indispensable. Methods for simultaneous direct dynamic measurements in both time and real space domains needed to be devised and applied. Spectroscopy with novel space-resolution and ultrafast spectroscopy with high sensitivity have been developed, the manipulation and fabrication of single molecules, nanoparticles, and single living cells have been realized, molecules and nanoparticles for probing chemical reactions spectroscopically and by imaging have been synthesized, new catalyses for cleaning air and new reactions have been found, and the way in which a reaction in a single molecular crystal leads to its morphological change has been elucidated under the umbrella of this research program. The recent development of these new methods and the advances in understanding chemical reaction dynamics in nanosystems are summarized in the present two volumes.

The presented results are based on our activities over three years, including 1146 published papers and 1112 presentations at international conferences. We hope readers will understand the present status and new movement in Molecular

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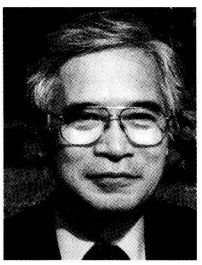
and Sapporo
August 2009

Hiroshi Fukumura
Masahiro Irie
Yasuhiro Iwasawa
Hiroshi Masuhara
Kohei Uosaki

About the Editors

Hiroshi Fukumura received his M.Sc and Ph.D. degrees from Tohoku University, Japan. He studied biocompatibility of polymers in the Government Industrial Research Institute of Osaka from 1983 to 1988. He became an assistant professor at Kyoto Institute of Technology in 1988, and then moved to the Department of Applied Physics, Osaka University in 1991, where he worked on the mechanism of laser ablation and laser molecular implantation. Since 1998, he is a professor in the Department of Chemistry at Tohoku University. He received the Award of the Japanese Photochemistry Association in 2000, and the Award for Creative Work from The Chemical Society Japan in 2005. His main research interest is the physical chemistry of organic molecules including polymeric materials studied with various kinds of time-resolved techniques and scanning probe microscopes.



Masahiro Irie received his B.S. and M.S. degrees from Kyoto University and his Ph.D. in radiation chemistry from Osaka University. He joined Hokkaido University as a research associate in 1968 and started his research on photochemistry. In 1973 he moved to Osaka University and developed various types of photoresponsive polymers. In 1988 he was appointed Professor at Kyushu University. In the middle of the 1980's he invented a new class of photochromic molecules – diarylethenes - which undergo thermally irreversible and fatigue resistant photochromic reactions. He is currently interested in developing single-crystalline photochromism of the diarylethene derivatives.

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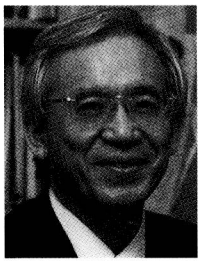

Yasuhiro Iwasawa received his B.S., M.S. and Ph.D. degrees in chemistry from The University of Tokyo. His main research interests come under the general term "Catalytic Chemistry" and "Surface Chemistry", but more specifically, catalyst surface design, new catalytic materials, reaction mechanism, in situ characterization, oxide surfaces by SPM, time-resolved XAFS, etc. His honors include the Progress Award for Young Chemists in The Chemical Society of Japan (1979), The Japan IBM Science Award (1990), Inoue Prize for Science (1996), Catalysis Society of Japan Award (1999), The Surface Science Society of Japan Award (2000), Medal with Purple Ribbon (2003), and The Chemical Society of Japan Award (2004). The research reported by Yasuhiro Iwasawa represents a pioneering integration of modern surface science and organometallic chemistry into surface chemistry and catalysis in an atomic/ molecular scale. Iwasawa is a leader in the creation of the new filed of catalysis and surface chemistry at oxide surfaces by XAFS and SPM techniques.

Hiroshi Masuhara received his B.S. and M.S. degrees from Tohoku University and Ph.D. from Osaka University. He started his research in photochemistry and was the first to use nanosecond laser spectroscopy in Japan. He studied electronic states, electron transfer, ionic photodissociation of molecular complexes, polymers, films, and powders by developing various time-resolved absorption, fluorescence, reflection, and grating spectroscopies until the mid 1990s. The Masuhara Group combined microscope with laser and created a new field on Microchemistry, which has now developed to Laser Nano Chemistry. After retiring from Osaka University he shifted to Hamano Foundation and is now extending his exploratory research on femtosecond laser crystallization and laser trapping crystallization in National Chiao Tung University in Taiwan and Nara Institute of Science and Technology. He is a foreign member of Royal Flemish Academy of Belgium for Science and the Arts and his honors include The Purple Ribbon Medal, Doctor Honoris Causa de Ecole Normale Superier de Cachan, Porter Medal, the Chemical Society of Japan Award, Osaka Science Prize, and Moet Hennessy Louis Vuitton International Prize "Science for Art" Excellence de Da Vinci.

Kohei Uosaki received his B.Eng. and M.Eng. degrees from Osaka University and his Ph.D. in Physical Chemistry from Flinders University of South Australia. He was a Research Chemist at Mitsubishi Petrochemical Co. Ltd. From 1971 to 1978 and a Research Officer at Inorganic Chemistry Laboratory, Oxford University, U.K. between 1978 and 1980 before joining Hokkaido University in 1980 as Assistant Professor in the Department of Chemistry. He was promoted to Associate Professor in 1981 and Professor in 1990. He is also a Principal Investigator of International Center for Materials Nanoarchitectonics (MANA) Satellite, National Institute for Materials Science (NIMS) since 2008. His scientific interests include photoelectrochemistry of semiconductor electrodes, surface electrochemistry of single crystalline metal electrodes, electrocatalysis, modification of solid surfaces by molecular layers, and non-linear optical spectroscopy at interfaces.

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