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Professor Hiroshi Masuhara

Introduction

This issue of *Photochemical and Photobiological Sciences* contains 21 papers dedicated to Hiroshi Masuhara as a celebration of his 60th birthday (Plate 1). These articles, from 13 different countries, serve as a recognition of his outstanding contribution to photochemistry through the application of time-resolved spectroscopy to a variety of excited state dynamics, not only in solution but also in polymers, of adsorbed molecules at solid surfaces, of molecular crystals, and other inhomogeneous systems. Hiroshi Masuhara is also well known as a scientist who extensively introduced microscopy into the field of photochemistry, demonstrating that the combination of microscopy and laser spectroscopy opens up new fields of research. Many photochemical studies related to nano-materials and photon pressure effects, which are very active and fruitful areas of research nowadays, have originated from Hiroshi's innovative ideas and techniques. He always gladly welcomes young scientists into his research group, nurturing them to yield promising scientists for the next generation in the field of photochemistry. This virtue almost certainly originated from his childhood, resulting from the influence of his parents.

Life

Hiroshi Masuhara was born in Tokyo in 1944 and grew up in a family where his parents devoted much of their time and effort to helping orphans who lost parents in World War II. His father, Ryoji Masuhara, who had studied law at Kyoto University, was during the War an officer of the Japanese army and his mother, Midori Kawai, had studied Japanese literature at the Japan Women's University. The War changed Japanese society completely, and also the lives of Hiroshi's parents, who in 1945 decided to help the recovery by setting up social welfare systems for orphans. Hiroshi considered for a long

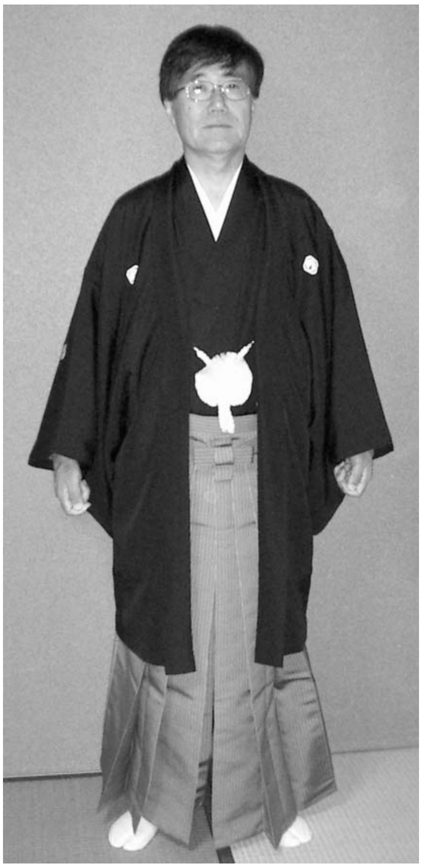

Plate 1 This photograph of Hiroshi Masuhara was taken to mark his 60th birthday. The kimono he is wearing, which was presented to him by his colleagues and students in March 2004, is called a hakama, a traditional kind of formal wear.

time that his future should involve work equivalent to that of parents however, after studying for three years in Professor Masao Koizumi's laboratory in the Department of Chemistry at Tohoku University in Sendai, he was convinced that research in Chemistry is valuable enough to bear comparison with the excellent work of his parents.

When Hiroshi moved to Professor Noboru Mataga's laboratory in Osaka University after taking the Master Course in Tohoku University in 1968, a nanosecond ruby laser was available there which he used to measure, for the first time, the excited singlet–singlet absorption spectra of electron donor–acceptor (EDA) complexes. His PhD thesis, completed in 1971, was entitled *Studies on the Electronic Structure and the Dynamic Behavior of the Electron Donor–Acceptor Complex in Its Lowest Excited Singlet State*. This research heralded the start of the nanosecond era in Japan, which of course was followed quickly by picosecond photochemical studies. Hiroshi, with Professor Mataga and several students, conducted systematic studies on EDA complexes and exciplexes, and elucidated their electronic structure and dynamics. Some of this pioneering research, particularly on ionic dissociation, is summarized in *Accounts of Chemical Research*, 1981, **14**, 312. Around 1980, Hiroshi's interest gradually shifted to molecular aggregates and polymers in solution, and then to their films and powders. The detection technique also shifted from absorption to reflectance spectroscopy, and his efforts became focused on improving the time-resolution. First, following the development of nanosecond diffuse reflection spectroscopy by one of us, Masuhara's group developed nanosecond, picosecond and femtosecond measurement systems not only using diffuse reflectance but also analysis methods for internal reflection and regular reflection spectroscopies. By utilizing these methodologies his group has been able to study important photophysical and photothermal processes and cooperative reactions characteristic of molecular solids in addition to the conventional isomerisation, electron transfer and energy transfer processes.

Hiroshi Masuhara's research on solid state photochemistry initiated with lasers taught him that photochemistry was expanding and laser chemistry was becoming more important as a new tool which induces heating, high pressures, expansion, melting, fragmentation, and even mechanical forces in addition to laser induced chemical reactions. Furthermore this

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tool can be conducted freely in space at arbitrary times. Hiroshi recognized the importance of interdisciplinary areas of photochemistry and understood deeply the high potential of photochemistry in modern science and technology. In 1984 he was appointed Professor in the Faculty of Textile Science and Engineering of Kyoto Institute of Technology, and it was whilst working there that the exceptionally high standard of his work and his ingenuity were recognized when ERATO (Exploratory Research of Advanced Science and Technology) funded the Masuhara Microphotoconversion Project of Japan Science and Technology Agency, 1988–1994. He started to explore new photochemical and photophysical phenomena by developing time-resolved grating, scattering, and various micro/nano-spectroscopies, fs–ns imaging techniques, and micro/nano-manipulation and patterning methods, and several new interdisciplinary areas of molecular photoscience were initiated. Hiroshi moved to his present position as Professor in the Department of Applied Physics at Osaka University in 1991, where he continues to carry out innovative research of the highest standard. Hiroshi Masuhara's pioneering and seminal contributions cross borders of many research fields such as materials science, physics, optics, and lately even bioscience.

Research

Briefly, Hiroshi Masuhara's research activity can be summarized as follows.

1 Photophysical and photochemical processes leading to morphological changes

Intense pulsed laser excitation of micro/nano-droplets, aggregates, crystals, powders, and films generates a high density excited states and intermediates, and their interactions induce morphological changes. Hiroshi and coworkers are studying how molecular electronic excitation of molecular solids evolves to cause morphological changes. Representative examples are ns–nm expansion/contraction dynamics of amorphous/multi-crystalline films and polymer films involving glass/rubber phase transitions, and ns–fs ablation of neat aromatic liquids. In the latter case it was clearly demonstrated that photochemical dissociation reaction leads to ablation (*J. Phys. Chem. B*, 2002, **106**, 3049). These studies are now extended to microcrystals in solution and single bio-cells, leading to new proposals for nanoparticle preparation and cell manipulation.

2 Size dependence of molecular photochemical processes of single micro/nano-materials

Solvation dynamics, excimer formation processes, and triplet–triplet annihilation, and laser oscillation in single microdroplets have been elucidated, while by introducing microelectrodes, electron transfer processes and molecular diffusion from single droplets to surrounding solution were revealed. Thus, the micrometer size dependence of photochemical relaxation dynamics and reactions in single liquid droplets were clarified for the first time. Recently the Masuhara group has developed Rayleigh light scattering spectroscopy and studies of single gold nanoparticles, which show dependence of the scattering spectrum on size, shape, environment, and adsorbed molecules, and even revealed their ultrafast relaxation dynamics. At present this approach is being extended to organic nanocrystals (*J. Phys. Chem. B*, 2004, **108**, 7674), and size and shape changes during photochemical reactions of molecular nanocrystals can now be studied and followed directly.

3 Molecular processes controlled by photon pressure

Focused near-infrared lasers exert a photon force on micro/nano-materials, enabling their manipulation. Optical trapping, theoretically explained by Maxwell and confirmed experimentally by physicists, was first applied to molecular systems by the Masuhara group, giving interesting information. The minimum size of trapped particles in solution at room temperature was confirmed to be a few nanometres. The force is strong enough to suppress electrostatic repulsion between electrolytes and to break the hydrogen-bonding networks around polymers in water. Larger photon forces are exerted on molecules with higher polarizability (*J. Phys. Chem. B*, 1999, **103**, 1660). This was proved experimentally and even applied in order to form novel molecular association structures characteristic of the photon force.

Other scientific activities

Hiroshi Masuhara has contributed to the photochemistry world not only in scientific research but also as a member of associations and editorial boards and in organizing international conferences. He worked as a member of IUPAC Photochemistry Commission from 1998 to 2001. He was the President of the Japanese Photochemistry Association from 2000 to 2001 and he was largely responsible for the formation of the Asian and Oceanian Photochemistry Association of which he became the first president in 2002. He has served on the editorial boards of 13 international journals dealing with physical chemistry and photochemistry. These include *J. Phys. Chem.* (1999–2004), *Phys. Chem. Chem. Phys.* (1999–2002), *ChemPhysChem* (2001–2004), *Laser Chemistry* (1993–) and *J. Photochem. Photobiol. A: Chem.* (as the Asian Editor from 1997 up to the present). In 2003, he was the joint chairperson of the excellent XXIst International Conference on Photochemistry held in Nara, the ancient capital of Japan.

Recognition

Hiroshi Masuhara's scientific achievement has been recognized widely and resulted in his receiving the Japanese Photochemical Association Award in 1989, the Vinci d'Excellence Trophy in the LVMH Moet Hennessy–Louis Vuitton Science for Art Competition in 1993, the Divisional Award of Chemical Society of Japan and the Osaka Science Prize in 1994. He was also honoured by being selected as a Foreign Member of the Royal Flemish Academy of Science, Literature and Art of Belgium in 1998 and he is still serving as a Member. He has been a Guest Professor at several universities in Europe as well as in Japan.

Hiroshi Masuhara's pioneering work has attracted many young researchers and graduate students to join his group. At present more than 40 doctors from his research group are working in relevant areas of molecular photoscience as professors and researchers. His seminal research work has been reported in over 400 original and innovative publications and in nine books, which he and his friends have edited and written. Hiroshi Masuhara's contribution to modern photochemistry is unparalleled and what he has brought to this field is highly innovative and of great lasting significance. In addition to his scientific excellence, he is also famous as a wonderful host, inviting foreign and domestic visiting scientists to his home. He enjoys cheerful conversation with delicious dinners, which are expertly prepared and presented by his charming wife, Nobuyo Masuhara. Every scientist who has been invited to their pleasant home for dinner will never forget their hospitality and cordiality. It is great pleasure for the contributors to this special issue to dedicate their articles to Hiroshi Masuhara and we are happy to join them in wishing him further success and happiness in the coming years.

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