

**Seminar in Laboratoire de Spectrochimie Infrarouge et Raman  
Universite de Lille, France  
November 4, 2013**

# **Exploration, elucidation, and application of femtosecond laser-induced phenomena in molecular and bio systems**

**Hiroshi MASUHARA**

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National Chiao Tung University,  
Hsinchu 30010, Taiwan**

**1960**

**Laser oscillation was demonstrated.**

**Late 1960s**

**3 lasers were introduced to physical chemistry laboratories in Japan.**

**1967**

**Norrish, Porter, Eigen were awarded Nobel Prize due to their fast kinetic study of chemical reaction.**

**1968**

**Masuhara shifted to Mataga laboratory as the 1<sup>st</sup> year Ph. D student of Osaka University and this autumn a Ruby laser was set there. Masuhara belongs to the first generation who had a chance to use lasers for Ph. D works.**

**1968**

**Prof. Mataga said to Masuhara that all light sources would be replaced by lasers in future, so new chemistry would be opened by lasers.**

**I understood that my Ph. D would be given when I would demonstrate something new as photochemistry.**

**Practically I set up and measured nanosecond absorption spectroscopy of CT complex for the first time, which received much attention. But I knew it just followed Porter's way and was far from exploratory research.**

**My initial trial was to improve time-resolution of electronic absorption spectroscopy of solution.**

**Nanosecond, picosecond, and femtosecond**

**The second trial was to develop time-resolved reflection spectroscopy for films and powders.**

**Diffuse, specular, and total internal reflection**

**Still I felt that we were following Porter's way**

**The third trial was to develop time-resolved spectroscopy under confocal microscope.**

**Picosecond, femtosecond**

**Then shifted to transient grating spectroscopy, near field fluorescence microscopy, single nanoparticle spectroscopy, and so on.**

**In parallel we have been exploring molecular phenomena utilizing femtosecond laser.**



INTERNATIONAL SERIES OF  
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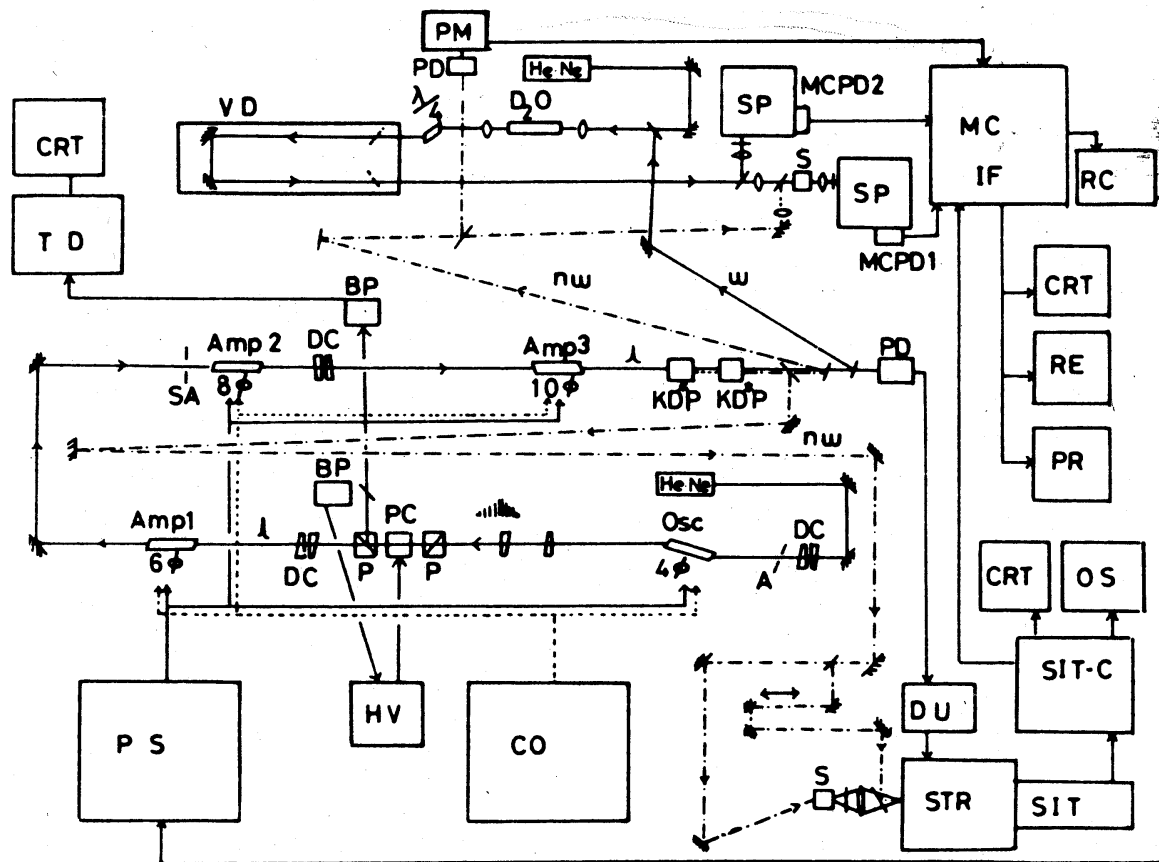
# Chemical Applications of Ultrafast Spectroscopy

Graham R. Fleming

# Chemical Applications of Ultrafast Spectroscopy

GRAHAM R. FLEMING  
*The University of Chicago*

OXFORD UNIVERSITY PRESS *New York*  
CLARENDON PRESS *Oxford*  
1986



Schematic diagram of a picosecond Nd-YAG laser photolysis system. DC, dye cell; A, aperture; P, polarizer; PC, Pockels cell; BP, biplanar phototube; PD, photodiode; PM, power meter; TD, transient digitizer; VD, variable delay; SP, spectrograph; S, sample; MC, microcomputer; IF, interface; RC, remote control; RE, recorder; PR, printer; DU, delay unit; STR, streak camera; SIT, SIT camera; SIT-C, SIT camera controller; OS, oscilloscope.

*Miyasaka, Masuhara, Mataga, Laser Chemistry, 1983, 1, 357*

OPPORTUNITIES IN  
**Chemistry**

Committee to Survey Opportunities in the  
Chemical Sciences

Board on Chemical Sciences and Technology

Commission on Physical Sciences,  
Mathematics, and Resources

National Research Council

**1985**

**Pimentel Report**

**“Laser, SOR, and Computer will create the next chemistry”**

NATIONAL ACADEMY PRESS  
Washington, D.C. 1985

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1990

North-Holland  
Delta Series

### Photochemical Processes in Organized Molecular Systems

Edited by  
K. Honda

Proceedings of the Memorial Conference for  
the late Professor Shigeo Tazuke  
Yokohama, Japan  
September 22-24, 1990

1991

North-Holland  
Delta Series

### Dynamics and Mechanisms of Photoinduced Electron Transfer and Related Phenomena

Edited by  
N. Mataga  
T. Okada  
H. Masuhara

Proceedings of the Yamada Conference XXXI on  
Dynamics and Mechanisms of  
Photoinduced Electron Transfer  
and Related Phenomena

1994

North-Holland  
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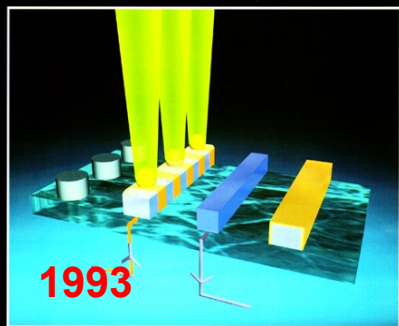
### Microchemistry Spectroscopy and Chemistry in Small Domains

Edited by  
H. Masuhara (Editor-in-Chief)  
F. C. De Schryver  
N. Kitamura  
N. Tamai

## マイクロ化学

微小空間の反応を操る

増原極微変換プロジェクト 編



1993

化学同人



Chemistry for the 21st Century

## Organic Mesoscopic Chemistry

Edited by H. Masuhara  
& F. C. De Schryver

1999



NANO SCIENCE  
AND TECHNOLOGY

H. Masuhara  
H. Nakanishi  
K. Sasaki (Eds.)

## Single Organic Nanoparticles



2003

2005

## レーザーが拓く ナノバイオ

増原 宏・細川陽一郎 著



NeoBook

*Books Edited and Written by Masuhara et al.*





HANDAI NANOPHOTONICS Volume 1



# Nanophotonics

Integrating Photochemistry, Optics and Nano/Bio Materials Studies

2004

Hiroshi Masuhara and Satoshi Kawata  
Editors



HANDAI NANOPHOTONICS Volume 2



# Nanoplasmonics

From Fundamentals to Applications

2006

Satoshi Kawata and Hiroshi Masuhara  
Editors



HANDAI NANOPHOTONICS Volume 3



# Nano Biophotonics

Science and Technology

2007

Hiroshi Masuhara and Satoshi Kawata  
Editors

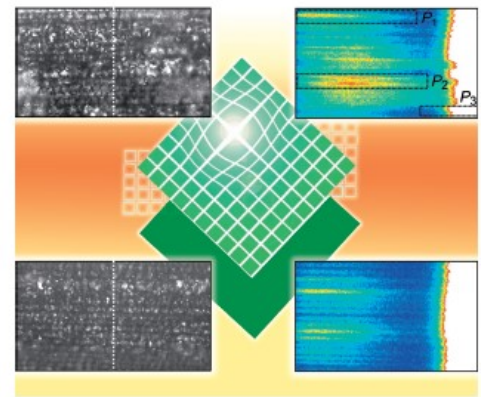
Edited by H. Fukumura, M. Irie, Y. Iwasawa, H. Masuhara, and K. Uosaki



# Molecular Nano Dynamics

2009

Volume 1:  
Spectroscopic Methods and Nanostructures



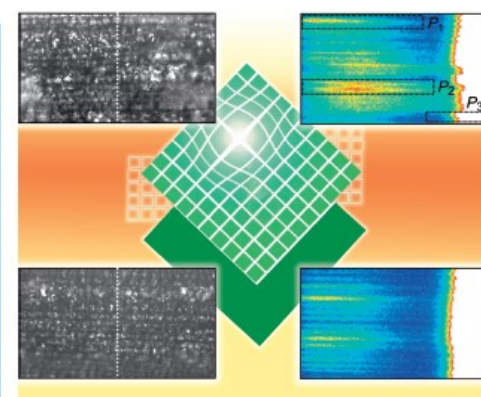
Edited by H. Fukumura, M. Irie, Y. Iwasawa, H. Masuhara, and K. Uosaki



# Molecular Nano Dynamics

2009

Volume 2:  
Active Surfaces, Single Crystals and Single Biocells



*Books Edited and Written  
by Masuhara et al.*

**Femtosecond absorption and imaging study on laser ablation  
dynamics of dye thin films, proving  
Photo-mechanical ablation mechanism**

**Femtosecond laser-induced crystallization of molecules in solution**

**Femtosecond manipulation of living cells by indirect irradiation**

**Laser trapping dynamics of nanoparticles by femtosecond laser pulses**

## Award Accounts

The Chemical Society of Japan Award for 2005

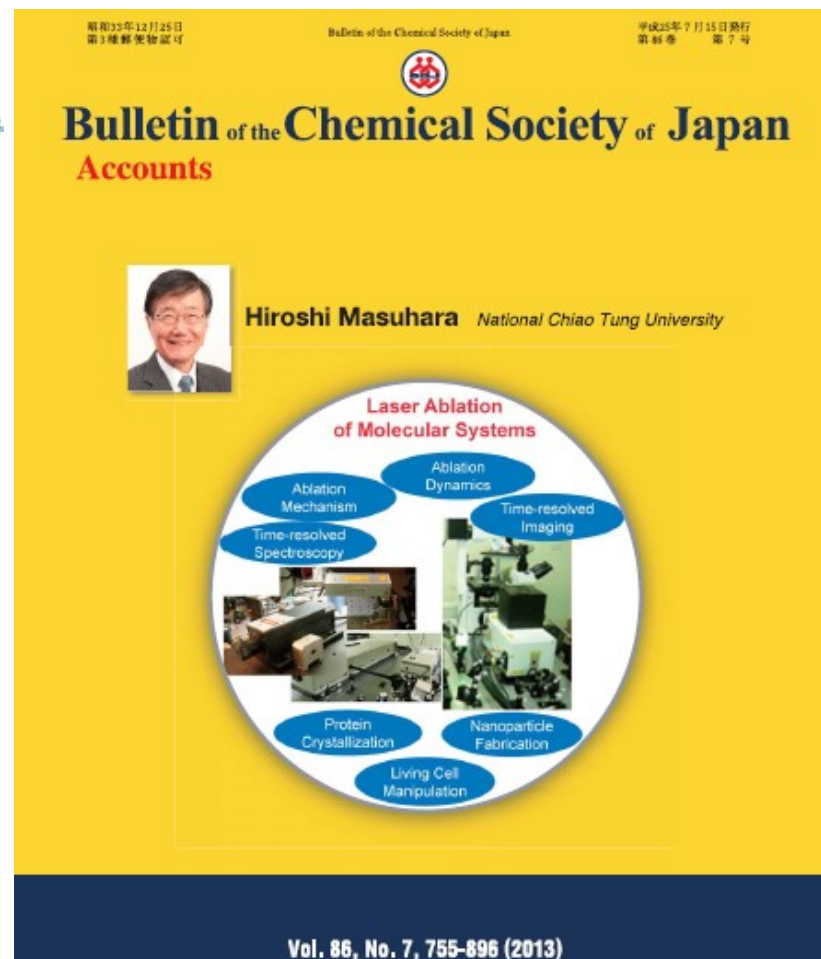
### Time-Resolved Spectroscopic and Imaging Studies on Laser Ablation of Molecular Systems: From Mechanistic Study to Bio/Nano Applications<sup>‡</sup>

Hiroshi Masuhara

Department of Applied Chemistry and Institute of Molecular Science, National Chiao Tung University,  
Ta Hsueh Rd. 1001, Hsinchu 30010, Taiwan

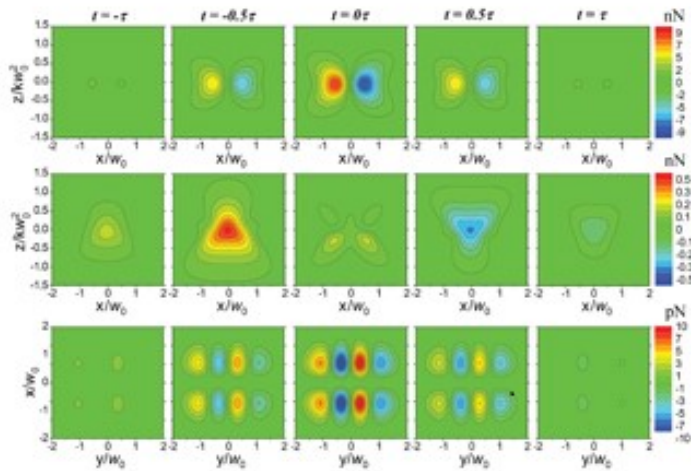
Received March 5, 2013; E-mail: masuhara@nctu.nctu.edu.tw

This accounts explained  
what I talked today.



# Trapping dynamics of nanoparticles by femtosecond laser pulses are summarized in this review

## SCIENCE PROGRESS *100 years of reporting science*



Volume 96 Part I 2013

SCIENCE REVIEWS 2000 LTD

## Science Progress,

### “Optical Trapping of Nanoparticles by Ultrashort Laser Pulses”

A. USMAN



W.-Y. CHIANG



H. MASUHARA



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**2013**

**Now I think that laser has given, is giving, and will give us enough exploratory chemical research.**