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Mitsui Chemicals, Inc.

Mitsui Chemicals Successfully Hosts the Fourth Catalysis Science Symposium

Mitsui Chemicals Inc. (“MCI”) announced today that the “The Fourth Mitsui Chemicals International Symposium on Catalysis Science (MICS2009)”, held on March 11 and 12 with the theme of “Catalysis Science and Its Contribution to Future Human Development“, drew to a successful close (see attached Fact Sheet). The symposium was attended by 1,600 persons from industrial, governmental and academic institutions. This symposium series has been organized since 2003 to further the development of catalysis science contributing to ”Dream-Inspiring Innovation”.

The event featured lectures from ten of the world’s front-line researchers in catalysis science, focusing on current status and future prospects of the catalysis science field, which plays a key role in resolving issues which encompass environment, energy, and resources in the 21st century. All the attendees were inspired by the enlightening lectures, including those presented by Nobel Laureates, Professor Roald Hoffmann of Cornell University and Wolf Prize Laureate, Emeritus Professor Henri B. Kagan of Université Paris-Sud. After the lectures, vigorous exchanges were held between the lecturers and attendees about the presentations and research.

Also taking the opportunity of the symposium, MCI hosted the award ceremony for the “2009 Mitsui Chemicals Catalysis Science Award” and “2009 Mitsui Chemicals Catalysis Science Award of Encouragement” where commemorative lectures where given by the award winners. The awards are presented to researchers who have made outstanding achievements in catalysis science.

Overview of the Symposium

1. Name of the Symposium:

The Fourth Mitsui Chemicals International Symposium on Catalysis Science
"Catalysis Science and Its Contribution to Future Human Development"

2. Date/Venue:

Date: March 11-12, 2009
Venue: Kazusa Akademia Hall (Kisarazu City, Chiba Prefecture, Japan)

3. Lecturers:

Plenary Lectures

Prof. Roald Hoffmann (Cornell University, U.S.A.)
The 1981 Nobel Prize Laureate in Chemistry

Emeritus Prof. Henri B. Kagan (Université Paris-Sud, France)
The 2001 Wolf Prize Laureate in Chemistry

Invited Lectures

Emeritus Prof. Bernard Witholt (Swiss Federal Institute of Technology, Zurich)
Dr. Robert J. Farrauto (BASF Catalysts LLC, U.S.A.)
Prof. Kyriacos C. Nicolaou (The Scripps Research Institute and the University of California, San Diego, U.S.A.)
Prof. Barry M. Trost (Stanford University, U.S.A.)
Prof. Ei-ichi Negishi (Purdue University, U.S.A.)
Prof. Yasuhiro Iwasawa (The University of Tokyo, Japan)
Prof. Masakatsu Shibasaki (The University of Tokyo, Japan)
Dr. Shin-ichiro Tawaki (Mitsui Chemicals, Inc., Japan)

Commemorative Lectures

Winners of the "2009 Mitsui Chemicals Catalysis Science Award"
Prof. John F. Hartwig (University of Illinois, U.S.A.)
Prof. Kyoko Nozaki (The University of Tokyo, Japan)

Winners of the "2009 Mitsui Chemicals Catalysis Science Award of Encouragement"
Dr. Shigeki Matsunaga (The University of Tokyo, Japan)
Assistant Prof. Yoshiaki Nakao (Kyoto University, Japan)

4. Attendance: Ca. 1,600 persons

5. Sponsoring Organizations:

Hosted by: Mitsui Chemicals, Inc.
Supported by:
Government: Chiba Prefecture, Sodegaura City, Ichihara City, Kisarazu City, Mobara City

Academia:	The Chemical Society of Japan
	The Society of Polymer Science, Japan
	Catalysis Society of Japan
	The Japan Petroleum Institute
	The Society of Synthetic Organic Chemistry, Japan
	The Society of Chemical Engineers, Japan

Appendix－1

【Opening Ceremony】

Chairman of the MICS 2009 Organization Committee
President & CEO, Mitsui Chemicals, Inc.
Kenji Fujiyoshi

Good morning, dear distinguished speakers, guests, and ladies and gentlemen. Welcome to “The Fourth Mitsui Chemicals International Symposium on Catalysis Science,” MICS2009. It is a great honor to host a Symposium with so many distinguished guest speakers and participants – from the industrial, governmental and academic communities of the world.

With the aim of “contributing broadly to society through innovations and the creation of materials, while keeping in harmony with the global environment” and to support the development of catalysis science, a fundamental technology in realizing this aim, Mitsui Chemicals has been organizing “The Mitsui Chemicals International Symposium on Catalysis Science (MICS)” since 2003. The themes of the first, second and third symposiums were “Advanced Catalysts for Polymers”, “Green Catalysts for Specialty Chemicals” and “Polymerization Catalysis － Current Status and Future Prospects”, respectively. Mitsui Chemicals invited world-famous scientists in the field of catalysis science to deliver lectures and to engage in lively discussions.

At this Fourth Mitsui Chemicals International Symposium, MICS 2009, with the theme of “Catalysis Science and Its Contribution to Future Human Development”, we hope to discuss the current status and future prospects of catalysis science, which will play a key role in resolving issues encompassing the environment, energy and resources in the 21st century as well as support sustainable development of humankind in the future.

At this Symposium, we are fortunate to welcome ten of the top leaders in catalyst science, representing both industrial and academic communities.

Today, the Nobel Prize Laureate in Chemistry for 1981, Professor Roald Hoffmann of Cornell University will deliver a plenary lecture. Following his lecture will be three guest speakers: Professor Yasuhiro Iwasawa of the University of Tokyo, Emeritus Professor Bernard Witholt of the Swiss Federal Institute of Technology, Zurich, and Dr. Shin-ichiro Tawaki of Mitsui Chemicals.

Tomorrow, the Wolf Prize Laureate in Chemistry for 2001, Emeritus Professor Henri B. Kagan of Universite Paris-Sud will present a plenary lecture. And we will also have lectures by: Professor Masakatsu Shibasaki of the University of Tokyo, Dr. Robert J. Farrauto of BASF Catalysts LLC, Professor Kyriacos C. Nicolaou of the Scripps Institute and the University of California, San Diego, Professor Barry M. Trost of Stanford University, and Professor Ei-ichi Negishi of Purdue University.

This afternoon, we will be holding the “Mitsui Chemicals Catalysis Science Award” ceremony as well as have commemorative lectures by the award winners. I am confident that all the presentations and lectures will be inspiring and enlightening.

In closing, I wish to take this opportunity to express my deepest gratitude to all those persons and organizations, in particular, six academic societies as well as five local and regional governments and others concerned, who have directed their kind encouragement and support toward making this Symposium a reality.

I sincerely hope that this Symposium would serve as a forum of extensive as well as intensive interchange among researchers from around the world and be an excellent opportunity for creating new knowledge in catalysis science contributing to Future Human Development.

Thank you for your kind attention.

【Summary of lectures】

〔Plenary Lectures〕

＜Plenary lecture ①＞

Chemistry's Essential Tensions: Different Ways of Looking at a Science

Prof. Roald Hoffmann (Cornell University, U.S.A.)

Professor Roald Hoffmann, a theoretical chemist, has successful taught his colleagues how to think differently about electrons influencing molecular structure and reactivity. He developed approximate methods for calculating electronic structure, and introduced new ways of dealing with electrons in molecules that has led to a better understanding of stereoselectivity in organic chemical reactions (The Woodward-Hoffmann rules). He was awarded the 1981 Nobel Prize in Chemistry jointly with Dr. Ken-ichi Fukui "for their theories, developed independently, concerning the course of chemical reactions".

He is not only a chemist but also a writer of poems, plays and nonfiction, often related to science, but reaching a general audience. In this lecture, he showed different ways of looking at chemistry, stressing its psychological dimension and its tie to culture and the arts.

＜Plenary lecture ②＞

Asymmetric Catalysis[*1], a Promising Route to Biologically Active Compounds or Their Synthetic Intermediates

Emeritus Prof. Henri B. Kagan (Université Paris-Sud, France)

Emeritus Prof. Kagan has made a major contribution to the field of chirality. He pioneered the field of Rhodium complex catalysis introducing the concept of C2 symmetric[*2] diphosphine ligands (DIOP) and is a pioneer of catalytic asymmetric hydrogenation that sponsored the subsequent development of asymmetric catalysis. Additionally, Prof. Kagan discovered asymmetric amplification, i.e., a phenomenon in which the optical purity[*3] of a product becomes higher than that of the catalyst or substrates, a discovery that is expected to play an important role in revealing the origin of chirality regarding biological compounds. Prof. Kagan is also a pioneer in the application of samarium iodide to organic synthesis thus providing a foundation for the development of lanthanoid reagents (catalysis) today.

This lecture presented some practical applications of enantioselective hydrogenation or oxidation, and the scope and the future of asymmetric catalysis has been also discussed.

[*1] Asymmetric catalysis: Catalysis that can produce a desired stereochemical structure selectively.

[*2] C2 symmetric: 180º rotation about an axis through the molecule that results in a geometry equivalent to the starting geometry.

[*3] Optical purity: An index of how much one enantiomer is more than another enantiomer. It affects the optical properties of compounds.

〔Invited Lectures〕

＜Invited Lecture ①＞

Chemical Design and Dynamic Structures on Catalyst Surfaces for Innovative Processes

Prof. Yasuhiro Iwasawa (The University of Tokyo, Japan)

Prof. Iwasawa is a leading authority on solid surface science and catalysis and has developed proprietary methodologies for elucidating the surface chemistry of heterogeneous catalysts at the atomic level that could not be analyzed using conventional methods.

In this lecture, Prof. Iwasawa introduced some examples of proton transfer that play a significant role in many chemical and biological processes in fuel cells and enzymatic reactions, and atomic-level characterizations of metal oxide surfaces that are of great interest to those who work in the catalysis and nanotechnology fields. He also talked about the catalytic mechanism behind the direct oxidation of benzene to phenol as revealed by in-situ time-resolved XAFS*.

*In-situ time-resolved XAFS: A method to observe the reaction points on the surface of heterogeneous catalysts by X-ray analysis.

＜Invited Lecture ②＞

Industrial Chemistry with Whole Cell Biocatalysts

Emeritus Prof. Bernard Witholt (Swiss Federal Institute of Technology Zurich)

Emeritus Professor Witholt is a pioneer in the field of biooxidation and biohydroxylation of organic compounds using microorganisms, and he has been developing biocatalysts harbouring oxygenases and reaction processes in nonpolar solvents. Oxygenase is a unique enzyme which catalyses oxygenation reactions, however, the industrial application of this enzyme is a challenge vis-a-vis other enzymes widely used in industry. The challenging feature of this enzyme is that electron donors are required, i.e. NADH or NADPH and its complex structure, and that it is difficult to apply this enzyme in vitro.

Emeritus Professor Witholt has utilized gene recombination technology and optimized biocatalytic systems to successfully progress towards the economically feasible industrial application of the oxygenase reaction system. In his lecture, he explained how reaction processes using biocatalysts had been developed and their contribution to Green Chemistry.

＜Invited Lecture ③＞

Development of Novel Biocatalysts for the Production of Useful Chemicals from Biomass

Dr. Shin-ichiro Tawaki (Mitsui Chemicals, Inc., Japan)

Dr. Tawaki has developed a series of novel biocatalysts for the production of useful chemicals from biomass.

In detail, Dr. Tawaki and co-workers have developed an efficient chromosome modification technique for gene introduction and deletion that can enhance target pathways and the interception of by-product pathways as a way to accelerate the production of D-lactate, a precursor of hydroquinone (2-deoxy-scyllo-inosose) and propylene (isopropanol) from biomass.

In this lecture, Dr. Tawaki described this strategic biocatalyst design for the production of useful chemicals, in addition to talking about glucose production from inedible biomass resources like cellulose.

＜Invited Lecture ④＞

Recent Progress in Asymmetric Two-Center Catalysis

Prof. Masakatsu Shibasaki (The University of Tokyo, Japan)

Professor Shibasaki is one of the world leaders in the field of asymmetric catalysis. He developed the concept of two-center asymmetric catalysis consisting of a strictly designed chiral ligand and two or more metal centers that play different roles in the catalytic mechanism, such as the activation of a substrate or the control of its conformation. This concept differs from the conventional mono-metal-center catalyst concept and has led to new asymmetric reactions that have never been achieved with conventional catalysts leading to the asymmetric synthesis of pharmaceutical products.

In this lecture, he introduced new catalytic asymmetric reactions using bimetallic Schiff base complexes, the multimetallic BINOL complexes and amino acid derivatives, and catalytic asymmetric synthesis of Ranirestat and Tamiflu.

＜Invited Lecture ⑤＞

Automotive Emission Control: Past, Present and Future

Dr. Robert J. Farrauto (BASF Catalysts LLC, U.S.A.)

Dr. Farrauto, a research fellow at BASF Catalysts LLC, has made substantial contributions to the industrialization of automobile emission control catalysts and has also established the world's first commercialization technology for non-precious metal catalysts for diesel engines. He is presently developing fuel-cell catalysts for the next generation of automobiles.

In this lecture, he talked about the history of the development of automobile catalysts from the 1970's to the present in conjunction with the changes in automotive emission control standards. He also introduced current fuel cell technology leading to the possibility of a hydrogen economy.

＜Invited Lecture ⑥＞

Catalysis in Total Synthesis

Prof. Kyriacos C. Nicolaou (The Scripps Research Institute and the University of California, San Diego, U.S.A.)

Prof. Nicolaou is a world authority on the total synthesis of complex and large natural products affecting the fields of organic synthesis, chemical biology, and medical advancements.

Prof. Nicolaou's lecture highlighted applications of catalytic reactions as represented by cross-coupling and metathesis reactions (useful for molecular frame formation) or asymmetric catalytic reactions (useful for the building of chiral centers) in total synthesis and demonstrated how such endeavors lead to the discovery and development of new catalytic reactions for chemical synthesis.

＜Invited Lecture ⑦＞

On Inventing Reactions for Atom Economy

Prof. Barry M. Trost (Stanford University, U.S.A.)

Prof. Trost's career has ranged over the entire field of organic synthesis and his research interests include the invention and development of atom economic reactions that are based upon transition metal catalysts and their use to define strategies that result in the total synthesis of complex molecules largely of biological significance. Prof. Trost is the original proponent of the atom economy*.

In this lecture, Prof. Trost discussed atomic economic methodologies that center on redox isomerization reactions on ruthenium catalyzed processes, and the coupling reaction of alkene-alkyne couplings, and the total synthesis of bryostatin using atom economic methodologies.

* Atom economy: That proportion of all atomic conversion efficiency in the chemical process. The atom economic process shows the least waste and is eco-friendly.

＜Invited Lecture ⑧＞

Transition Metal-Catalyzed Organometallic C-C Bond Formation Reactions That Have Revolutionized Organic Synthesis

Prof. Ei-ichi Negishi (Purdue University, U.S.A.)

Prof. Negishi is a pioneer in the area of transition metal-catalyzed organic synthesis. He discovered or co-discovered a number of reactions for Carbon-Carbon bond formation, notably: (a) Pd-catalyzed cross-coupling with organometals containing Al, Zn, and Zr (this reaction is widely known as “Negishi Coupling”), (b) Zr-catalyzed alkyne carboalumination*[1], and (c) the ZACA reaction*[2].

In this lecture, attention primarily was focused on recent advances in the Pd-catalyzed synthesis of alkenes, dienes, enynes, diynes, and their oligomers. Also discussed in some detail were the Zr-catalyzed alkyne carboalumination and the ZACA reaction. Their basic methodological developments and applications to complex natural products were also discussed.

*1 Carboalumination: A reaction that Carbon-Carbon bond formation and Carbon-Aluminium bond formation generates to both ends of an unsaturated bond.

*2 ZACA reaction: Zr-catalyzed Asymmetric Carboalumination of alkenes.

〔Commemorative Lectures〕

＜“2009 Mitsui Chemicals Catalysis Science Award” ①＞

Discovery and Development of New Coupling and C-H Bond Functionalization Reactions

Prof. John F. Hartwig (University of Illinois, U.S.A.)

Professor Hartwig has made pioneering contributions to catalytic carbon-hydrogen bond activation, one of the unsolved challenges in catalytic science, and he has realized new types of transformations, including highly efficient coupling reactions. His approach to catalyst development has led to deep insights into reaction mechanisms.

He has developed catalysts that functionalize the terminal C-H bonds of alkanes through metal-boron bonds and has revealed an unusual mechanism for the C-H bond cleavage step. No other system catalyzes such selective functionalization of terminal C-H bonds with any reagent. He has also developed the palladium-catalyzed amination of aryl halides, and α-arylation of carbonyl compounds, etc. His catalysts are extremely practical and have been universally adopted.

This lecture focused on these new coupling and C-H bond functionalization processes and the fundamental underpinnings of these reactions.

＜“2009 Mitsui Chemicals Catalysis Science Award” ②＞

Development of Novel Catalytic Reactions for Coordination Copolymerization of Polar Monomers

Prof. Kyoko Nozaki (The University of Tokyo, Japan)

Professor Nozaki is one of the leaders in the field of homogeneous catalysis. She has developed various new catalysts for organic synthesis, the target molecules being of various molecular sizes, from small molecules to polymers. She has achieved the metal-catalyzed coordination polymerization of olefins with polar monomers, which has been one of the major challenges in the field of olefin polymerization.

Although coordination copolymerization of olefins with polar monomers allows for syntheses of a wide range of polymer structures which are not accessible with other polymerization methods, it is not an established fact due to strong coordination of polar functional groups to the metal center. Professor Nozaki has designed a palladium complex with a phosphine-sulphonate ligand through systematic syntheses of complexes and has succeeded in the synthesis of a linear copolymer of ethylene and acrylonitrile and the synthesis of an alternate copolymer of vinyl acetate with carbon monoxide for the first time in the world. In this lecture she talked about coordination copolymerizations of polar monomers using this palladium complex.

＜“2009 Mitsui Chemicals Catalysis Science Award of Encouragement” ③＞

Development of Multimetallic Asymmetric Catalysis through Chiral Ligand Design

Dr. Shigeki Matsunaga (The University of Tokyo, Japan)

Dr. Matsunaga developed the concept of “multimetallic concerto asymmetric catalysis”. He designed chiral catalysts with two or more metal centers with different properties, where one metal center functions as a Lewis acid to activate an electrophile, and the other metal interacts with a nucleophile to control its orientation. This innovative concept is different from traditional catalyst design, and has opened up new possibilities in asymmetric synthesis.

In this lecture, Dr. Matsunaga revealed the concept of multimetallic concerto catalysis, and the chiral design based upon this, and the synthetic application to biologically active compounds.

＜“2009 Mitsui Chemicals Catalysis Science Award of Encouragement” ④＞

Carbon-Carbon Bond Forming Addition Reactions Catalyzed Cooperatively by Nickel and Lewis Acid

Assistant Prof. Yoshiaki Nakao (Kyoto University, Japan)

Dr. Nakao has developed new Carbon-Carbon bond forming addition reactions through C-H and C-C bond activation by the cooperative action of nickel catalysts with Lewis acids.

In this catalytic system, the C-H or C-C bond of molecules coordinating to Lewis acid is likely activated by nickel, and the following insertion of unsaturated bonds is cooperatively promoted.

Dr. Nakao has uncovered a unique nickel catalyst for C-H bond activation, although nickel has been rarely employed for this activation. Additionally, he has discovered that use of a Lewis acid facilitates the activation of C-H bonds. Using this cooperative catalyst, he has achieved direct C-H functionalization under mild conditions and has succeeded in promoting addition reactions of nitriles across unsaturated bonds through the activation of the C-CN bonds.

In this lecture, he introduced the addition reaction of pyridine across alkynes, the carbocyanation reactions of alkynes, and uncovering of key reaction intermediates.