GSCN was established in 2000 to promote research and development for the Environment and Human Health and Safety, through the innovation of Chemistry .

Looking at Planet Earth from Space

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In the predawn hours of March 11, 2008, the Japanese Experiment Module *Kibo* was launched into orbit aboard the Space Shuttle *Endeavor* from the NASA's Kennedy Space Center in the state of Florida in the US. Docking with the International Space Station (ISS) went smoothly, all mission tasks were accomplished, and all the crew members returned to Kennedy Space Center on March 26, all according to schedule. Takao Doi's light-hearted vivid descriptions of life on board the space station, the first such account by a Japanese astronaut, made a deep impression. I think that many people gained a closer familiarity with space exploration through this event. It certainly had a lasting impression on me, having watched the lift-off first hand at Cape Canaveral.

Also fresh in my memory is the way people were so deeply affected by the high-definition sequence of images showing the rising and setting of the Earth taken from the surface of the moon by the satellite *Kaguya*. It is somehow a little disconcerting to see the Earth in the way that we're used to looking at the moon, but the pictures forcefully brought home the realization to many that the Earth is indeed a globe that moves regularly in the solar system just like other planets. The strikingly beautiful image of the fully-illuminated Earth captured by the crew of *Apollo 17* was used to great effect by Al Gore, former Vice President of the US, in his book, *An Inconvenient Truth*. Looking at this image, it's hard to conceive that our one and only planet Earth is enveloped by a layer of greenhouse gases and suffering from climate change.

Thanks to ongoing progress of the space program, we have all become fairly familiar with looking back at planet Earth from the far reaches of space. The surface consists of nothing but brown patches of land and blue patches of water, with no dotted lines demarking national borders to be seen. Our planet is enveloped by a special atmosphere creating a unique life-sustaining environment that is very different from the empty reaches of outer space. Even if we have known this intellectually, the images of Earth really brought the message home in a tangible way. This visual sense of reality is critically important when it comes to seriously confronting climate warming and other global scale challenges.

This ability to look back at our planet Earth from space certainly goes way beyond the mundane bird's-eye view. This ability to capture clear and objective images of our home planet is an amazing thing. Let us hope that we can derive wisdom from these visions.

The 8th Annual Green and Sustainable Chemistry Symposium

The 8th Annual Green and Sustainable Chemistry Symposium was held on Friday and Saturday, March 6-7, 2008 in the Hitotsubashi Memorial Auditorium of the National Center of Sciences. Organized around the central theme *GSC practices and prospects toward a sustainable society*, prominent scientists from industry, academia, and government were brought together in one place, and the latest information and findings pertaining to GSC were presented and discussed in a very lively atmosphere by 450 participants. The symposium featured ten lectures by invited speakers, five presentations by GSC award winners, and 136 short poster presentations. Poster award winners were selected, and an awards ceremony was held that was followed by a reception.

The symposium began with opening remarks by Satoshi Kawachi, President of the GSC Network, at 10:30 in the morning on March 6. After greeting and thanking the speakers and participants, Mr. Kawachi called for continued support for the GSC Network highlighting 1) the critical role of chemical technology in solving resource, energy, environmental, and other present-day challenges, 2) the growing importance and potential of chemical technology in the years ahead, and 3) the absolute necessity of achieving revolutionary chemical technologies based on GSC ideals through close collaboration between industry and academia with greater support from the government.

Mr. Kawachi's remarks were followed first by the ten invited lectures—starting with Tokyo University Professor Shu Kobayashi's paper *Human-Useful Environmentally Benign Organic Synthesis* and concluding with Mr. Eiji Tanaka's presentation on *GSC within the Mitsubishi Chemical Holding Group* the next day—and then by five presentations by the previous GSC award winners. The content offered in-depth treatment of a rich variety of topics ranging from the latest cutting-edge technological developments to a thought-provoking paper that cast doubt on over-optimistic assessments of Japan-African relations.

On the afternoon of March 6 was a 2 1/2-hour poster session, during which 136 presentations were heard on a wide range of new technologies and other subjects including new synthetic methods, catalysts, alternative solvents, green products, recycling, biotechnology, bioplastics, resources and energy, environmental cleanup and restoration, and education. A ceremony was then held to present 4th GSC poster awards to the younger researchers and scientists. This year there were 66 applicants. Members of the selection committee listened to the presentations, posed questions to the speakers, and selected six winners who received commendations and awards the same day. We will introduce the recipients in the next edition of the *GSCN News Letter*. Here we would like to express our sincere thanks to the judges for their advance preparation, listening to the presentations, and for their thoughtful consideration in choosing the winners.

The 7th GSC awards ceremony was held in the evening of March 6 at the Star Hall, Josui Kaikan. The award winners were called to the front by name to receive certificates and plaques of achievement from our most distinguished guests—Keiko Terui, Director-General of Manufacturing Industries Policy for METI; Kanji Fujiki, Deputy Director-General of Minister's Secretariat for MEXT; Masatoshi Ishizuka, Director General of the Environmental Health Department; and Satoshi Kawachi, President of the GSC Network—amid thunderous applause from the 240 people in the audience. Following the awards ceremony, a reception was held where Mrs. Terui and Messrs. Kawachi, Fujiki, and Ishizuka made brief speeches, and Mitsuo Kawano, Director of the Noguchi Institute, toasted the winners.

This symposium was made possible through the generous support of the Asahi Glass Foundation. In addition, assistance was received from 70 groups and organizations. The GSC Network consists of 25 affiliated bodies and organizations, and close to 100 groups and organizations that empathize with and endorse the GSC symposiums, giving the distinct impression that the momentum behind green and sustainable chemistry is growing stronger and more widespread every year.

Finally, I would like to express my great appreciation to all the speakers, the participants, and the members of the GSC Network symposium committee for all their efforts in making this year's symposium the best and most successful ever!

METI,
Yuji Tokumasu

The Tokyo Univ.,
Shu Kobayashi, Ph.D.

Ritsumeikan Asia Pacific Univ.,
Sanga Ngoie Kazadi, D. Sc.

Lecture Hall

Poster Presentation

Reception

Catalytic polymerization process of THF by solid acid supported on meso-porous material

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Once the market of a certain chemical is growing very rapidly, it is required to substitute the conventional synthetic technology to more efficient catalytic technology because of the problem of side-product, process-efficiency and cost-effectiveness. We will introduce the industrial technology, in which a solid acid polymerizes tetrahydrofuran (THF) to reduce the catalyst waste to almost zero-level.

An environmentally benign catalytic polymerization process for the production of polyoxytetramethylene glycol (PTMG) has been developed and established industrially. Market demand for PTMG, a raw material produced for elastic fibers, is growing rapidly. This new continuous flow process includes the polymerization of THF under the presence of acetic anhydride by solid acid catalysis on meso-porous support.

Conventional PTMG production technology is a batch process composed of three main steps, namely catalyzed polymerization by fluorosulfonic acid (FSO_3H), hydrolysis of polymers and neutralization of FSO_3H by Ca $(OH)_2$. FSO_3H is a very corrosive and harmful liquid and requires special materials for the reactors, which need periodical maintenance and renewal, and very careful attention throughout the operation. In addition the use of FSO_3H generates a significant amount of fluolo-containing waste material (0.15kg waste per 1kg-PTMG).

In this new technology, a mixed solid oxide composed of ZrO_2 and SiO_2 was successfully introduced as the catalyst for the polymerization of THF under the presence of acetic anhydride. By using this non-corrosive and harmless catalyst, the technology has achieved near-zero emission levels of catalyst waste. More precisely, the amount of catalyst's residue reduces to below 1 kg per 1 ton of PTMG. It is also confirmed that the deactivated catalyst can be generated by careful calcination. We can estimate that ca. 4500 ton of catalyst waste is eliminated annually and can establish the commercial process by using ca. 60% of the investment of conventional process.

In general, heterogeneous catalyst can be easily separated from products and, compared with the homogeneous catalyst, has many advantages for industrial use. However, in the case of polymerization technologies, we can find few practical examples due to the declining performance of the catalysis in a longer term. This is caused by the hindered diffusion of the produced bulky molecules in the pores of the support. In this new technology, by using well-dispersed and well-defined solid acid on the SiO_2 support with meso-pores, in which a bulky polymer molecule can diffuse easily, the production of high-quality PTMG with stable polydispersity, less amount of oligomer and low product color-index due to tiny amount of by-products, can be realized.

In summary, this technology realizes high productivity of high-quality product while reducing the amount of waste to zero by replacing conventional batch technology that utilizes catalysis with a high environmental load with continuous flow technology that is more easily handled and which enjoys more neutral catalysis. It has been concluded that this technology is a good example of industrialization of green sustainable chemistry.

Meso-porous materials have been investigated through the world since early 1990s and this technology strongly demonstrates the superiority and sound capabilities of meso-porous materials as a catalyst support in terms of easy diffusion of bulky product materials. Further research in this area is expected.

The 7th Green and Sustainable Chemistry Awards Winners

Green and Sustainable Chemistry Awards are to be granted annually to those who greatly contributed to promote GSC through their R&D, industrialization, education, new philosophy/methodology establishment.

The achievements are awarded either by the Minister of Economy, Trade and Industry, or by the Minister of Education, Sports, Culture, Science and Technology, or by the Minister of the Environment,. The 7th GSC Awards Winners are as follows.

-The 7th Green and Sustainable Chemistry Award
Awarded by the Minister of Economy, Trade and Industry
"The Development of an Environmentally Benign THF Polymerization Process Utilizing Solid Acid Catalysis"
Toru Setoyama, Mitsuharu Kobayashi
Mitsubishi Chemical Group Science and Technology Research Center, Inc.
Minoru Tanaka, Hiroshi Takeo, Mitsubishi Chemical Corporation
Teruo Yoshida, Mitsubishi Chemical Engineering Corporation

GSC Awards Winners

-The 7th Green and Sustainable Chemistry Award
Awarded by the Minister of Education, Culture, Sports, Science and Technology
"Contribution to Education and Dissemination of Green & Sustainable Chemistry"
Emeritus Professor Kazuko Ogino, College of Medical Sciences, Tohoku University

- The 7th Green and Sustainable Chemistry Award
Awarded by the Minister of the Environment
"Development of New Watch Lubricant for Decrease of Burdens on the Environment."
Yuji Akao, Citizen Watch Co., Ltd.

-The 7th Green and Sustainable Chemistry Award
"Development of Advanced Molecular Transformation of Alkenes by Low-valent Ruthenium Catalysts"
Professor Teruyuki Kondo, Graduate School of Engineering, Kyoto University

-The 7th Green and Sustainable Chemistry Award
"Development of Selective Oxidation Systems by Fine Control of Metal Oxide Cluster Catalysts"
Professor Noritaka Mizuno, School of Engineering, the University of Tokyo