

4 October, 2011

Social Outreach Seminar: Producing Hydrogen  
via Solar Energy-Driven Water Splitting

—On the road to making practical use of hydrogen,  
the ultimate clean renewable energy resource—

School of Engineering, The University of Tokyo  
The KAITEKI Institute, Inc.  
Mitsubishi Chemical Group Science and Technology Research Center, Inc.  
INPEX CORPORATION

School of Engineering, The University of Tokyo (Bunkyo-ku, Tokyo; Dean: Takehiko Kitamori), The KAITEKI Institute (head office: Minato-ku, Tokyo; President: Yoshimitsu Kobayashi), Mitsubishi Chemical Group Science and Technology Research Center (head office: Yokohama, Kanagawa Prefecture; President: Kizo Shibata), and INPEX CORPORATION (head office: Minato-ku, Tokyo; President: Toshiaki Kitamura) have established a Social Outreach Seminar “The Chemical Process of Solar Energy Conversion”, which focuses on the development of a hydrogen production process utilizing solar power-driven water splitting. The Seminar will be carried out over three years, starting in August 2011.

In recent years, with problems of energy and natural resources become more serious, the importance of forward progress in the development of renewable, clean sources of energy, has grown substantially.

Hydrogen is seen as holding tremendous promise as the ultimate renewable energy resource. This is due to the fact that when hydrogen combusts, all that is produced and left behind is water, making it an exceedingly clean source of energy. As well, in its reactions with carbon dioxide gas (a chief contributor to global warming), it is possible to create hydrocarbon fuels and other chemical materials.

However, under the current circumstances, most hydrogen is being produced by using non-renewable resources, such as methane and petroleum. While a method using electrolysis powered by electricity collected in solar batteries is thought to be feasible, the cost is high from a practical application perspective.

As such, innovative production methods which would allow for the direct generation of hydrogen through solar energy-driven water splitting have a significant amount of appeal.

The School of Engineering, The University of Tokyo, has been seeking a method to produce hydrogen directly using solar power, joint research with The KAITEKI Institute

and Mitsubishi Chemical Group Science and Technology Research Center. At this time, INPEX CORPORATION, Japan's largest oil and gas exploration and production (E&P) company with operations spanning 26 countries around the world, has now participated in establishing this Seminar.

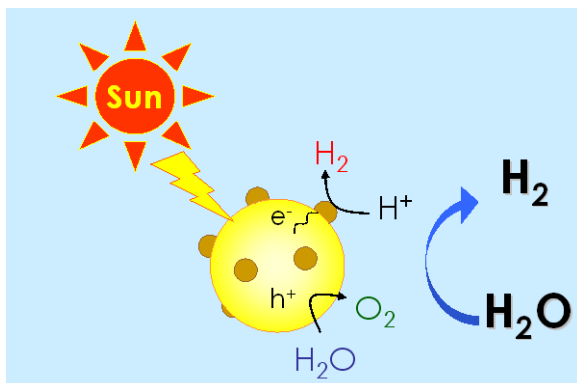
With regard to the hydrogen generation via water splitting using photocatalysis, an extremely high degree of efficiency is thought to be realizable in the case of using only ultraviolet light which is contained in the sun's rays. In the case of using the sunlight in its entirety, however, numerous challenges lie ahead in increasing its production efficiency.

To meet such challenges, it is understood to collect comprehensively the wide range of knowledge such as those regarding electronic properties of solids, catalysis science, inorganic and organic synthetic chemistry, the physical properties of fluids, process synthesis, and chemical engineering.

Professor Kazunari Domen, School of Engineering, the University of Tokyo, who is a pioneer of this field, will operate the Seminar to advance the world's most cutting-edge research to develop a hydrogen generation process driven by water split using solar photocatalysis.

The KAITEKI Institute, Mitsubishi Chemical Group Science and Technology Research Center, and INPEX CORPORATION are viewing the hydrogen production process, driven by water splitting using solar photocatalysis, with a great deal of promise as a mid- to long-range renewable energy and natural resources production. In evaluating the economic viability of this process, the perspective of industry is also reflected in this initiative, which further contributes to the acceleration of research progress.

Diagram: Generating hydrogen with water splitting using solar photocatalysis



A photocatalyst is composed of an optical semiconductor, represented here by the large sphere, and a number of cocatalysts, which are shown resting on said large sphere.

In taking in sunlight, an electron hole ( $h^+$ ) and an electron ( $e^-$ ) are generated. The electron hole oxidizes the water, and oxygen ( $O_2$ ) is formed. As well, the proton  $H^+$  which was formed simultaneously will react with the aforementioned electron  $e^-$  on the cocatalyst, and form hydrogen  $H_2$ .

#### Open Seminar Outline

- (1) Lecture Name: Seminar on the Chemical Process of Solar Energy Conversion
- (2) Location: School of Engineering, The University of Tokyo
- (3) Lecture Period: Three years, commencing in August 2011
- (4) Research Partners:  
The KAITEKI Institute, Inc.  
(100% subsidiary of Mitsubishi Chemical Holdings Group. An RD think tank conducting research and surveys focused on long-term issues, spanning 20-50 years from now.)  
Mitsubishi Chemical Group Science and Technology Research Center, Inc.  
(The RD arm of Mitsubishi Chemical Holdings Group.)  
INPEX CORPORATION  
(Japan's largest oil and gas exploration and production (E&P) company with operations spanning 26 countries around the world.)
- (5) Instructors: Kazunari Domen (Professor), Masao Katayama (Assistant Professor), Tsutomu Minegishi (Assistant Professor)
- (6) Research Goal: To develop the relevant materials and process for realizing effective utilization of solar and hydrogen energy.

“Social Outreach Seminars” are lectures carried out at The University of Tokyo faculties or research groups, which receive funding from business corporations looking to participate in joint research efforts, whose objectives reap significant benefits to the public good.

*For inquiries regarding this bulletin*

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