MSE-Colloquium@NTU

3 November 2017, 3:00 pm

Lecture Theatre 11, Nanyang Technological University, Singapore

Particulate Photocatalyst Systems for Water Splitting

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Abstract

Water splitting driven by solar energy has attracted much attention as a means of renewable solar hydrogen production. Both the efficiency and scalability of water splitting systems are important factors for practical utilization of renewable solar hydrogen. Development of particulate photocatalysts which are active in water splitting without any external power supply is ideal because they do not need any secure electrical circuits and thus can be spread over a wide area by inexpensive processes.

In my talk, development of particulate photocatalysts and systems for overall water splitting will be presented. My talk will consist of three sections: (i) solar energy conversion by water splitting, (ii) photocatalyst materials for overall water splitting, and (iii) photocatalyst sheets for two-step excitation (Z-scheme) water splitting.

In the first section, the motivation to utilize particulate photocatalysts for solar energy conversion will be presented. In the second section, active oxide photocatalysts for water splitting via one-step excitation will be reviewed. These include $SrTiO_3$ doped with Al and loaded with $RhCrO_x$ as a hydrogen evolution co-catalyst, which can split water into hydrogen and oxygen at an apparent quantum yield of 56% at 365 nm and a solar-to-hydrogen energy conversion efficiency (STH) of 0.6%. The processing methods of such a highly active photocatalyst for potentially extensible forms will also be demonstrated. Subsequently, the development of active materials for overall water splitting under visible light will be presented, using $(Ga_{1-x}Zn_x)(N_{1-x}O_x)$ as an example, along co-catalysts. In the third section, the development of particulate photocatalyst sheets based on hydrogen evolution photocatalyst (HEP) and oxygen evolution photocatalyst (OEP) embedded into conductive layers by particle transfer will be presented. The STH of water splitting using photocatalyst sheets consisting La- and Rh-co-doped $SrTiO_3$ ($SrTiO_3$:La,Rh) as a HEP and Mo-doped $BiVO_4$ as an OEP reaches 1.1%. The reaction properties of such photocatalyst sheets will be discussed in detail.

Future challenges of photocatalytic water splitting will be presented as concluding remarks.

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Biography

Assistant Professor Hisatomi Takashi received his PhD in Engineering from the University of Tokyo under Professor Domen's supervision in March 2010. In April 2010, he joined the Laboratory of Photonics and Interfaces at École Polytechnique Fédérale de Lausanne for 2 years as a postdoctoral fellow, and was supervised by Professor Michael Grätzel. Thereafter, he joined Professor Domen's group at the University of Tokyo in April 2012 and was promoted to Assistant Professor in August 2012. Assistant Professor Hisatomi's major research interests include materials development and device design for photocatalytic and photoelectrochemical water splitting for solar energy, as well as kinetic assessments of photocatalysis and photoelectrochemistry. Assistant Professor Hisatomi has 96 publications and has an Hirsch index of 31.

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