

國立台北科技大學化學工程與生物科技系「國際短期訪問特聘教授」專題演講

題目：Solar Fuels

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## Solar Fuels

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**Keyword:** photoelectrochemistry, water splitting, hydrogen generation, solar energy

Energy crisis is a broad and complex global topic. Natural resources such as gas and oil are limited in supply. Development towards renewable resources is one of the most important technologies in the world. Currently, photocatalytic and photoelectrochemical (PEC) water splitting devices under the irradiation of sunlight have received much attention for the production of renewable hydrogen from water. Solar energy conversion and storage through photoelectrolysis of water using semiconductors as both light absorber and energy converter to store solar energy in simple chemical bond,  $H_2$ , become highly desirable approaches to solving the energy shortage challenge.

We focus on the effort to develop an efficient Si-based PEC water splitting device. We introduce the surface textured Si heterojunction PEC cell consisting of ultrathin amorphous Si/crystalline Si as efficient and robust photoelectrodes. The solar to hydrogen conversion efficiency has been improved to 13.26%, which is the highest ever reported for Si-based photocathodes. Later on, we design the cascading energy band structure in Si via doping for facilitating carrier separation and novel electrode structures for 360° light harvesting for hydrogen generation with ultrahigh current densities of  $61.2 \text{ mAcm}^{-2}$ . The cells have been further demonstrated with excellent hydrogen production rate. In addition, our method can significantly improve the stability of Si-based solar cells in water to sustain up to 300 hr. These multifunctional designs provide the potential for the future development in the renewable energy market.

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Dr. Jr-Hau He is the Professor in Materials Science and Engineering at City University of Hong Kong. He got BS and PhD degrees at National Tsing Hua University in 1999 and 2005, respectively. Dr. He was a professor in Electrical Engineering at National Taiwan University and King Abdullah University of Science and Technology (2007-2019). He has been an influential scientist in optoelectronics. He has made a major contribution to understanding light-matter interaction, which reflects on his achievement of photon management on the light harvesting devices.

He serves as a member of the editorial board for numerous prestigious journals, and as a chair, co-chair, and a member of technical and steering committees for national and international symposiums. He is the Editor-in-Chief of IEEE Nanotechnology Council (NTC) Newsletter. He serves as IEEE Electron Device Society (EDS) and NTC Distinguished Lecturer, SPIE Visiting Lecturer and OSA Travelling Lecturer. He is a Fellow of OSA, RSC and SPIE, and a senior member of IEEE. 38 postgraduate students (16 Ph.D. and 27 M.S. students) under his supervision completed their degree studies.