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Editorial

Photocatalysis and Photoelectrochemistry for Solar Fuels

Zhigang Zou,[1] Jinhua Ye,[2] Michael R. Hoffmann,[3] and Wenjun Luo[1]

[1]*Department of Physics, Ecomaterials and Renewable Energy Research Center (ERERC), Nanjing University, Nanjing 210093, China*
[2]*International Center for Materials Nanoarchitectonics (MANA), National Institute for Materials Science (NIMS), Tsukuba 3050044, Japan*
[3]*Linde-Robinson Laboratories, California Institute of Technology, Pasadena, CA 91125, USA*

Correspondence should be addressed to Zhigang Zou; zgzou@nju.edu.cn

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The Sun generates enough energy to power the Earth. However, solar energy should be stored into chemical energy to be conveniently used due to its low energy density and discontinuous radiation. In the last several years, photocatalysis and photoelectrochemistry for solar fuels have reattracted more and more governments' and people's interest from all over the world and become a very hot topic. If we utilize the abundant solar energy to convert CO_2 into hydrocarbon fuels especially, it would address the problems of global climate change and solar energy storage at the same time. Recently, different new materials and ideas have been proposed and steady scientific progress has been done. However, it is still a key challenge to explore visible-light responsive materials with high photocatalytic activities. The special issue contains eight papers, where 6 papers are related to visible-light activity and 2 papers are related to UV activity.

In a paper entitled "*Development of thin film amorphous silicon tandem junction based photocathodes providing high open-circuit voltages for hydrogen production*" by F. Urbain et al., they prepare the a-Si:H/a-Si:H based photocathodes, which exhibit a high photocurrent onset potential of 1.76 V versus the reversible hydrogen electrode (RHE) and a photocurrent of 5.3 mA/cm^2 at 0 V versus RHE. They provide an efficient and low-cost route to solar hydrogen production.

In a paper entitled "*Bottom-up enhancement of g-C_3N_4 photocatalytic H_2 evolution utilising disordering intermolecular interactions of precursor*" by X. L. Wang et al., they develop a bottom-up strategy to synthesize g-C_3N_4 photocatalysts with improved optical property and chemical structure through using disordered dicyandiamide (D-DCDA) as reaction precursor. The carbon nitride sample condensed by D-DCDA indicates higher photocatalytic activity for hydrogen evolution due to looser structure and more effective light harvesting and charge separation efficiency.

In a paper entitled "*Structure, optical properties, and photocatalytic activities towards H_2 generation and CO_2 reduction of GaN nanowires via vapor-liquid-solid process*" by H. Pang et al., they synthesize high quality single crystalline GaN nanowires with large aspect ratio on n-type Si (111) substrate via the Au-catalyzed vapor-liquid-solid process. Photocatalytic H_2 evolution and CO_2 reduction over the as-prepared GaN nanowires are also investigated. Their results suggest that the GaN nanowires greatly enhanced capability compared to the GaN powders.

In a paper entitled "*Band-gap engineering of $NaNbO_3$ for photocatalytic H_2 evolution with visible light*" by P. Li et al., they shift the photoabsorption edge of $NaNbO_3$ to the visible-light region by La and Co codoping. Moreover, H_2 is successfully generated over the doped $NaNbO_3$ samples under visible-light irradiation. Density-functional theory calculations show that Co-induced impurity states are formed in the band gap of $NaNbO_3$, which is considered to be the origin of visible-light absorption upon the doped $NaNbO_3$ sample.

In a paper entitled "*Sensitization of perovskite strontium stannate $SrSnO_3$ towards visible-light absorption by doping*" by H. Chen and N. Umezawa, they calculate electronic structures of $SrSnO_3$ after Cr^{3+}, Fe^{3+}, and Rh^{3+} and anions N^{3-}, N^{2-}, and S^{2-} doping. Among all considered cation dopants, Rh^{3+} gives rise to the deep in gap states. The transition from Rh^{3+} to $SrSnO_3$ conduction band is 0.89 eV lower than the band gap.

In a paper entitled "*Surfactant-free synthesis of single crystalline SnS_2 and effect of surface atomic structure on the photocatalytic property*" by M. Li et al., they prepare sheet like tin disulfide SnS_2 single crystal exposed with well-defined {001} facets and flowerlike SnS_2 mainly exposed with {010} facets through a surfactant-free solvothermal process. The sheet like SnS_2 showed a much higher photocatalytic activity in degradation of methyl orange than flowerlike SnS_2. Theoretical and experimental results reveal that the band structure derived from the surface atomic structure played a more important role than the surface energy in the photocatalytic property.

In a paper entitled "*Preparation of cerium modified titanium dioxide nanoparticles and investigation of their visible light photocatalytic performance*" by J. Liu et al., they prepare CeO_x/TiO_2 by the hydrothermal-calcination method. The Ce ions have the two valence states, Ce^{3+} and Ce^{4+}, which can act as the electron acceptor to improve the separation efficiency of the photogenerated electron-hole pairs.

In a paper entitled "*Visible-light degradation of dyes and phenols over mesoporous titania prepared by using anthocyanin from red radish as template*" by Z. Yan et al., they prepare highly crystalline mesoporous titania by using a natural pigment from red radish as template. The prepared mesoporous titania photocatalyst exhibited significant activity under visible-light irradiation for the degradation of dyes and phenols due to its red shift of band-gap-absorption onset and visible-light response as a result of the incorporation of surface carbon species.

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Zhigang Zou
Jinhua Ye
Michael R. Hoffmann
Wenjun Luo