Semiconducting Hetero-Nanostructures with Novel Configurations for Photoelectrochemical Water Splitting

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Energy production and environmental pollution are the two major problems the world is facing today. The depletion of fossil fuels and the emission of harmful gases into the atmosphere lead the research on clean and renewable energy sources. In this context, hydrogen is considered as an ideal fuel for meeting the global energy needs. Recent studies reveal that photoelectrochemical (PEC) water splitting has promise for solar to hydrogen conversion than the widely tested photocatalytic approach, as hydrogen and oxygen gases can be easily separated in PEC. Semiconductors are the primary choice of the light-absorbing materials, which undergo excitation upon solar light irradiation to produce excitons to drive the electrolysis. Visible light active semiconductors like $BiVO_4$ are attractive to achieve high solar to hydrogen conversion. However, pure semiconductor materials are far for practical applications due to either charge carrier recombination, poor light-harvesting and/or electrodes degradation. To overcome these issues, various attempts have been made to develop unique hetero-nanostructures with the integration of metal plasmons and/or suitable semiconducting materials. In this talk, we will discuss the novel hetero-nanostructures for PEC water splitting. Formation of heterostructures with metal-doping or metal plasmons appears to be beneficial, i.e., (i) Mo-dopant improves charge carrier density and transportation in $BiVO_4$ and hence higher PEC performance than $BiVO_4$. (ii) Decoration of plasmonic non-noble metal nanoparticles on photoelectrodes enhances the light absorption property and also reduces the recombination of photogenerated charge carriers.

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