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Hybrid metal-Cu²S nanostructures as efficient co-catalysts for photocatalytic hydrogen generation

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n recent years, hybrid nanocrystals (HNs) have emerged as an important class of materials to tune the optical, electrical, magnetic and catalytic properties of nanocrystals. In HNs, two disparate functional material systems (i.e., metal/magnet, metal/ semiconductor and magnet/semiconductor) are combined through their crystal facets, which results in the nontrivial synergetic effects including extinction enhancement due to the coupling of surface plasmon resonance and electronic doping by the intraparticle charge transfer. Among different types of HNs, metal-semiconductor HNs are of particular interest in photocatalysis because it can provide a very good light absorbing semiconductor properties and catalytically active metal nanostructure properties. In the previous report, Pt-CdS/Se NCs exhibited high photocatalytic activity as well as stability. However, the toxicity associated with cadmium based semiconductors has driven research into possible alternative materials. Copper (I) sulfide (Cu₂S), a p-type semiconductor with a narrow bandgap of 1.2 eV, has been explored as a light absorber in photovoltaics and optoelectronic devices due to its nontoxic and earth-abundant constituents. Also, Cu₂S nanostructures have also shown high catalytic activity for polysulfide redox systems in quantum-dot-sensitized solar cells. Cu,S nanocrystals with diverse shapes have been synthesized and employed in various applications. However, the synthesis and application of metal-Cu₂S HNs have rarely been reported. In this presentation, we introduce a new synthesis method for the fabrication of hybrid metal-Cu₂S (M=Pt, FePt) nanocrystals (HNs). The metal-Cu₂S HNs were investigated in photocatalytic hydrogen generation as effective co-catalysts on TiO₂. The Pt-Cu₂S/TiO₂ catalyst showed higher hydrogen generation rate compared with a pure TiO, catalyst. This enhancement is attributed to the synergetic effects between the Cu,S and Pt, which significantly improves the light absorption ability and the charge separation activity.



Biography

Prof. Jong-Soo Lee has been an associate professor of Department of Energy Science & Engineering since January 2017. He joined DGIST in July 2012 as an assistant professor. The research interestings of his group are design of new type of nanomaterials for nanomaterial-based electronic, optoelectronic, and catalytic applications.

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