Nanostructured Materials for Energy Related Applications

Hydrogen production through solar-driven water splitting: Cu(I) oxide-based semiconductor nanoparticles as the next-generation photocatalysts: Methods and protocols

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Abstract

Production of clean fuels like H(sub2) using renewable sources such as sunlight, through photoelectrochemical (PEC) system, is one of the promising approaches. For large-scale applications of the PEC devices, the photocatalystused should be of low cost, quite stable, and with high conversion efficiency for H(sub2) production. This chapter describes the application of Cu(I)-based binary and ternary oxide photocatalysts toward solar H(sub2) generation. Due to many advantages of Cu(I)-based oxides, including low bandgap energy, suitable band positions, high charge carrier mobility, and most importantly low cost and nontoxic nature, it has received significant attention in PEC water splitting reaction. Different synthetic routes, electrodeposition, atomic layer deposition, anodization, chemical vapordeposition, e-beam evaporation, pulsed laser deposition, sputtering, successive ionic layer adsorption and reaction, sol-gel, spray pyrolysis, thermal oxidation, etc., have been explored to obtain efficient Cu(sub2)O thin films. Employing suitable substrate offering better electrical connectivity facilitates the hole transport mechanism leading to improvement of water reduction process. Various co-catalysts have been identified, and application of different other compounds like metal oxides, carbon-based derivatives, etc. influences the separation of the photogenerated charge carriers, thereby enhancing the overall performance and stability of the materials.