

Synergistic Effect of Hybrid WS₂ Quantum Dots/Co-Fe Nanocubes, WS₂ Nanorods/Co-Fe Nanocubes: Towards Pt-Free Counter Electrode for Dye Sensitized Solar Cells

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Abstract

WS₂ (Transition-metal dichalcogenide) are known for their novel electro catalytic properties and have analogous structure with graphene. It is noted that catalytic performance of WS₂ can be further increased by doping either heteroatom or transition metal. Facile one-pot hydrothermal method was used for synthesis of WS₂ quantum dots and WS₂ nanorods, Nanocubes are prepared by simple chemical ageing method. The obtained WS₂ quantum dots, WS₂ nanorods show good transmittance in visible region (400 – 800 nm). The photoluminescence peak was obtained around 420 nm for WS₂ quantum dots, CoFe shows high intense peak at around 424 nm confirms the product quality. Raman active modes of CoFe around 501 cm⁻¹ (T_{1g}) and 620 cm⁻¹ (A_{1g}) reveals cubic structure formation. The structural features of the as prepared (0D/3D), (1D/3D) are characterized systematically by the X-ray diffraction, Field emission scanning electron microscopy, EDAX, High-resolution transmission electron microscopy, FTIR and Raman spectroscopy. Here we identified the synergistic effect of the prepared hybrid WS₂ quantum dots/Co-Fe nanocubes (0D/3D), WS₂ nanorods/ Co-Fe nanocubes (1D/3D) by appropriate doping composition shows more exposed edge sites, large specific surface area and outstanding catalytic activities, when compared with bare WS₂ and CoFe and it is a real substitute for Pt-counter electrode in Dye sensitized solar cells.

Keywords: WS₂ Quantum dots, WS₂ nanorods, Co-Fe nanocubes, Synergistic effect