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Band Gap Energy Modification of TiO_2 Photoelectrode By PbS/CdS Quantum Dot to Enhance Visible Region Photocurrent

Supriyono[1]*, Yuni Krisyuningsih Krisnandi[1], and Jarnuzi Gunlazuardi[1]

[1]Department of Chemistry, Faculty of Mathematic and Sciences, University of Indonesia, Kampus Baru UI Depok, Depok 16424, Indonesia

Abstract : TiO_2nanoparticles co-sensitized by CdS and PbS quantum dots (QD) were successfully prepared by a two-step process of sol gel method followed by successive ionic layer adsorption and reaction (SILAR) technique. Optical band gap energy and the particle size of the QD were determined from UV-Vis DRS spectra by using Tauc method and Brus model, respectively. XRD patterns indicated that the TiO_2nanoparticles have a nano-size crystallite range of 20-50 nm, while the DRS analysis showed that the optical band gap of TiO_2 and CdS were 3,34 eV and 2,38 eV, respectively. The diameter of CdS QD calculated by Tauc and Yu equation was around 9 nm. The shifted of optical band gap from UV to visible region was used to monitor the enhancement of visible photocurrent. Photoelectrochemical test showed that the TiO_2 (Eg = 3.34 eV) generated a photocurrent in the visible region of 0.01 mA/cm^2 and after TiO_2 coated by CdS (Eg = 2.38 eV) its photocurrent increased to 0.30 mA/cm^2. The results showed that the PbS/CdS co-sensitization have successfully enhanced the performance of TiO_2 photoelectrode by improving visible light adsorption efficiency and electron transport rate. We believe that this sensitizers and proposed structure have good prospects for photovoltaic development in the future.

Keywords: Optical bandgap, photoelectrochemical, quantum dot, sensitizer, TiO_2.

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