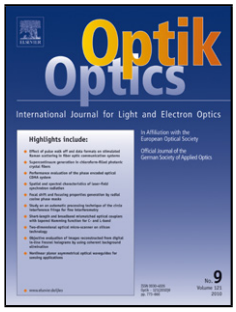

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Exploring the Effect of Morphology of Ni and Co Doped Cadmium Selenide Nanoparticles as Counter Electrodes in Dye-sensitized Solar Cell

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Abstract

Cadmium selenide (CdSe), cobalt and nickel doped cadmium selenide (Ni, Co-CdSe) nanoparticles were synthesized by solvothermal method. The structure, size, morphology and optical properties of the nanoparticles were characterized. The X-ray diffraction pattern supported hexagonal, wurtzite structure and the crystallite sizes were found to be 13.7, 11.94 and 10.07 nm for CdSe, Ni and Co-CdSe nanoparticles respectively and it was also confirmed by TEM analysis. Scanning electron microscopic (SEM) images showed that the dopants adhered to the substrate uniformly and the effective doping was further confirmed by EDX spectral analysis. The band gap energy was computed as 2.5, 3.4 and 3.8 eV for CdSe, Ni and Co-CdSe nanoparticles respectively from UV spectroscopic analysis. The kinetics of electron transport properties were studied by electrochemical analysis and it was found that Co-CdSe has more electrochemical activity compared to Ni-CdSe nanoparticles. DSSCs were fabricated with a dye immobilized semiconductor photo anode (TiO_2), redox active electrolytes, ruthenium dye as sensitizer and CdSe, Ni and Co-CdSe as counter electrodes. The maximum power conversion efficiency of solar cells were found to be 2.4 %, 4.1 % and 4.7% for CdSe, Ni and Co-CdSe nanoparticles and it was found that the dopants affect the morphology of the electrode materials which influence the efficiency of solar cell.

Keywords: Solvothermal, CdSe nanoparticles, electrochemical, photoluminescence, solar cell.

1. Introduction

Nanostructured materials are of significant interest due to their unique dimension dependent properties and their immense applications in electronics, sensors and bioimaging [1-3]. Two dimensional (2D) nanostructures, such as nanoplates, nanosheets and nanowalls are suggested as ideal components for nanoscale devices used in biological sensors, nanoswitches and data storage due to their high surface to volume ratio, nanometer–scale thickness and fascinating optical and photocatalytic activities [4-6]. One dimensional (1D) nanostructures are