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QUASI-SOLID STATE CADMIUM SULFIDE QUANTUM DOTS EMBEDDED PHOTOVOLTAIC CELLS WITH GEL ELECTROLYTE

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Quantum dots (QDs) are semiconductor nanoparticles exhibiting unique optical and electrical properties due to quantum confinement, which differ from those of the bulk material because of their nano-size. Quantum dot-sensitized solar cells (QDSSCs) belong to the third generation of solar cells and incorporate QDs into the photoanode, acting as photosensitizers. The structure of a QDSSC consists of a photoanode, an electrolyte and a counter electrode. The present study is focused on the preparation of quasi-solid state QDSSC with new polysulfide gel polymer electrolytes. A polysulfide electrolyte is used because it is more suitable for Cadmium Sulfide **(**CdS) quantum dot solar cells compared to other common electrolytes like I^-/I_3^-. In this study, multilayer Titanium Dioxide (TiO_2) photoanodes were fabricated using spin coating and doctor blade methods on Fluorine-doped Tin Oxide substrates. TiO_2 acts as the nanostructured metal oxide semiconductor layer, which mediates the electron transportation through the photoanode. CdS QDs, which are the light-harvesting species, were gradually grown on the mesoporous TiO_2 films using Successive Ionic Layer Adsorption and Reaction (SILAR) method. The room temperature conductivity of gel polymer electrolyte was 20.78 Ms/cm, and it increases with temperature. The cell performances were investigated by applying 10 SILAR cycles of CdS to the photoanode. In this study, 2-layer and 4-layer TiO_2 photoanodes were used with polysulfide gel electrolyte along with a Platinum counter electrode. The maximum efficiency of 0.76% was observed in CdS QDs-embedded solar cells with a 4-layer TiO_2 photoanode, with an open circuit voltage (V_{oc}) of 0.49 V and a short circuit current density (J_{sc}) of 3.71 mA/cm^2. The maximum efficiency of the cells fabricated with a 2-layer TiO_2 photoanode was 0.71% together with V_{oc} of 0.40 V and J_{sc} of 4.70 mA/cm^2. The higher efficiency of cells with a 4-layer TiO_2 photoanode demonstrates that increasing the number of TiO_2 layers enhances solar cell efficiency.

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