CdS Based Quantum Dot Sensitized Solar Cells

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Dye sensitized solar cells have been developed as an alternative to Silicon Solar cells to cut down the cost of solar cells. Dyes are used to harvest sunlight in this type of solar cells and high efficiencies are possible only with ruthenium based dyes which are expensive. An alternate approach to harvest light in sensitized solar cells is to use semiconductor quantum dots (QDs) instead of dyes. QDs can be easily prepared and they have better ability to absorb light as their band gaps can be controlled by their sizes because of quantum confinement. Due to absorption of light over a wider spectrum and due to the possibility of generating multiple carriers, the quantum dot sensitized solar cells (QDSSCs) can have theoretical conversion efficiencies in the range of 44%. In spite of these advantages, there are relatively few studies on such solar cells and the maximum efficiency reported so far is around 1.8% for cells employing liquid electrolytes. CdS, CdSe, PbS, PbSe, InP QDs which can absorb light in the visible region are used in QDSSCs. Among these, CdS QDs are widely used because of their suitable band gaps, long lifetime, important optical properties, excellent stability and easy fabrication.

Cadmium sulphide (CdS) based QDSSC have been fabricated with QDs prepared using sequential chemical bath deposition (CBD) technique and their photo-responses were investigated using one sun (AM 1.5, 100 mW cm^{-2}) illumination. The QDs were prepared in different concentrations of CBD solutions and tested in QDSSCs. The QDs grown in low concentration electrolytes showed best performance indicating that better quality QDs with good light absorbing property are produced when they are grown slowly.

The effect of different electrolytes on the QDSSC performance was investigated using standard commercially available iodide solution, 0.5 mol dm^{-3} aqueous Na_2S solution or a 1:1 mixture of above two solutions. The performance of the QDSSCs are strongly depends on the redox mediators present in the electrolyte. A QDSSC with mixed iodide and sulphide redox mediators showed the best performance with a J_{sc} = 2.1 mA cm^{-2}, V_{oc} = 386 mV, FF = 31.5 and efficiency of 0.26 %.