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Quantum Dots Adsorbed TiO_2 Photoelectrodes for a Photovoltaic Cell

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The dye-sensitized solar cell (DSSC) using nanocrystalline TiO_2 was pioneered by O'Regan and Gratzel and have been investigated intensively during the past three decades as a low cost alternative to conventional silicon solar cell. Current approaches to enhancing cell efficiency involve tuning the absorption spectrum and redox properties of different dyes. An alternative strategy is to replace the sensitizer as dye by semiconductor quantum dots. The electronic properties of the quantum dots can be tuned by changing the sizes of particles without changing the chemical composition. The use of quantum dots as sensitizers have advantages as compared to organic dyes that are adjustable band gap or band edge, and effective light harvesting.

CdSe as quantum dots was chosen as sensitizer because quantum confinement effects in CdSe have been widely studied and methods of controlling the size are well established. The final sizes of CdSe dots were controlled by changing the concentration of Cd and Se precursors. For application CdSe quantum dots as sensitizer, $CdSe/TiO_2$ films on conducting glass were employed in a sandwich-type cell incorporating platinum-coated conductive glass and electrolyte consisting of I^-/I_3^- redox. Absorbance and Photoluminescence experiments were carried out for investigating the optical properties of the cell. The cell was tested under AM 1.5 solar conditions and the photoelectrochemical behavior such as I-V characteristic and impedance was investigated by using 1287A potentiostat/galvanostat and 1255B Frequency Response Analyser (Solatron).