Optimization of TiO2 thin film thickness for dye sensitized solar cell applications

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Abstract
Dye sensitized solar cells (DSSCs) rely on the absorption of photons by the dye molecules which are transported to the conduction band of the TiO2 electrode. The microstructure, energy gap and the absorption spectra of the TiO2 electrodes highly affects the efficiency of the cell. In this paper, the absorption spectra and energy gap has been studied by varying the thickness of the TiO2 paste. Nanocrystalline TiO2 thin films were deposited on ITO glass substrate with three different thickness (4.54 µm, 7.12 µm and 12.3 µm) by using doctor blade method. After deposition all the samples were sintered at 450 degrees C after deposition to enhance the particle bonding and for achieving better adhesion. The samples were characterized by UV-VIS spectra for determining the absorption spectra and Scanning Electron Microscopy (SEM) for investigating the thickness and the surface morphology. Fabricating the electrodes with different thickness showed significant changes in the energy gap and from the results it can be concluded that the energy gap increases with the increased thickness. The highest energy gap of 2.25 eV and absorption 3.791 was achieved by 12.3 µm thick sample. The absorption spectra also shows better absorption throughout the whole visible light range but the SEM images suggest that 12.3 µm thick sample shows cracks all over the deposited region which will cause current leakage when the cell is assembled. Therefore, the optimum result was achieved by 7.12 µm thick sample providing 1.9 eV energy gap and 3.91 absorption peak.

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Showing 13 of 13  [View All in Cited References page](#) (from Web of Science Core Collection)

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