EFFECT OF ZnO LAYER THICKNESS ON THE EFFICIENCY OF ZnO-BASED ALL-SOLID-STATE DYE-SENSITIZED SOLAR CELLS

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The dye-sensitized solar cells (DSCs) provide a technically and economically credible alternative to present day p–n junction photovoltaic devices. Unlike the conventional systems where the semiconductor assume both the tasks of light absorption and charge carrier transport the two functions are separated here. Light is absorbed by a sensitizer, which is anchored on the surface of a wide band gap semiconductor. Charge separation takes place at the interface where photo-induced electrons inject from the dye into the conduction band of the solid. Charge carriers are transported through the conduction band of the semiconductor to the charge collector. The broad absorption band of the sensitizers in conjunction with oxide films of nanocrystalline morphology permits to harvest a large fraction of incident sunlight.

The solid-state dye-sensitized solar cells have shown higher stability over the conventional DSCs which use a liquid electrolyte. Here, instead of the liquid iodide/triiodide couple a copper iodide layer is used as a hole conductor. To avoid the short circuit problem a TiO_2 buffer layer has been introduced on to the FTO plates. The thin film was prepared by spraying 30 nm colloidal ZnO solution onto the buffer layer. These films were used to construct dye-sensitized solar cells (DSCs) with Indoline D-358 dye. The optimum efficiency (η) of 1.81% was obtained for the ZnO film with a thickness of 14 μm with the corresponding cell parameters of open circuit photovoltage (V_{OC}) of 501 mV, short-circuit current density (J_{SC}) of 10.65 mA cm^{-2} and a fill factor (FF) of 0.34, under air mass (AM) 1.5 illumination.