

Suppression of recombinations in dye-sensitized photoelectrochemical cells based on SnO₂ films coated with a thin layer of aluminum oxide

Dye sensitized (DS) photovoltaic cells are promising alternative to the conventional solar cells. The low photovoltage (V_{oc}) of these cells reduces the conversion efficiency mainly due to recombination losses. We have found that DS photoelectrochemical solar cell made from films of tin (IV) oxide coated with a thin layer of aluminum oxide yield high V_{oc} compared to cells made from bare tin oxide.

In preparation of the cell, SnO₂ dispersed in ethanol is sprayed onto CTO glass plate, sintered, kept immersed in a solution of ALCL₃ and sintered again. Then the films are coated with Ru bipyridal complex dye. The platinized CTO glass plate is kept in contact with the dyed film and electrolyte (0.5 M Tetrapropyl ammonium iodide and 0.05 M iodine in a mixture of acetonitrile and ethylene carbonate) is introduced to the capillary space between the plates. The XRD and SEM data confirmed the SnO₂ / Al₂O₃ film consists of SnO₂ crystallites of ~75 nm which the surface is coated with fine crystallites of ~2 - 4 nm.

The sensitization leading to photocurrent generation occurs via injection of an electron to conduction band (CB) of SnO₂ particle by tunneling through Al₂O₃ nano particle where the dye is adsorbed. When the electron and dye cation. The reaction of the CB electron with I₃⁻ ion at the electrolyte interface is also blocked by the Al₂O₃ at the same time. Suppression of recombination enables building up of the quasi-fermi level of electrons in SnO₂ and as a result an increase in the V_{oc} ~ 790 mV is observed. This is a significant enhancement compared with the observed V_{oc} of the cell made entirely of SnO₂, which is slightly above 300 mV.