

Dye Sensitized Solar Cells Based on TiO₂ Nanotubes and Enhancement of Efficiency of Solar Cells by the Treatment of Nanotube by TiCl₄

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Introduction of the Dyesensitized solar cells (DSSC) by MichealGretzel has opened up a new way to convert light energy in to electricity with economically viable cost. DSSC was originally constructed utilizing TiO₂nanocrystalline particles as an electron conducting medium. Despite of the high internal surface area, the random nature of the TiO₂nanocrystalline particle network results electrons to recombine reducing cell performance. In this investigation, TiO₂ nanotubes have been introduced instead of TiO₂ nanoparticles as they provide straight pathway to electron transport reducing charge recombination. TiO₂nanotubes were synthesized via hydrothermaltreatment.Theformation of nearly 10 nm diameter nanotubes was confirmed by Scanning Electron Microscopy analysis. TiO₂ nanotube based electrode was prepared by freeze drying the nanotube precipitate and re-suspends in water by ultrasoneing followed by electrophoretic deposition onto a conducting substrate (FTO) as anode and Pt as cathode. The optimum electro deposition potential, electrolyteand time was found to be 40 V, nanotube suspension and methanol 3:1 (v/v) ratio and 7 minutes respectively. The electrode was sensitized with cis-bis(isothiocyanato)bis(2,2'-bipyridyl-4,4'-dicarboxylato)-ruthenium(II) dye (N3) and iodine/triiodine redox couple was used as an electrolyte. Solar cell fabricated with TiO₂ nanotubes and sensitized with N3 dye showed an open circuit voltage (V_{oc}) of 820 mV and short circuit photocurrent density (J_{sc}) of 0.92 mA/cm² under 1.5 AM G irradiation. The solar cell device fabricated with TiCl₄ treated nanotube electrode showed V_{oc} of 804 mV and I_{sc} of 5.44 mA/cm². The treatment of TiO₂ nanotube electrode with TiCl₄ resulted in increase in solar cell efficiency from 0.52 % to 2 %.

Keywords: Hydrothermal, Nanocrystalline Nanotube, TiCl₄ treatment