Nano-porous TiO_2 photovoltaic cells sensitized with metallochromic triphenylmethane dyes: [n-TiO_2/triphenylmethane dye/p-I^-/I_3^- (or CuI)]

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Abstract

Photovoltaic cells capable of generating high photo-current densities and voltages were fabricated using metallochromic triphenylmethane type dye materials by depositing nano-porous TiO_2 films onto a thin film of SnO_2 coated conducting glass. Two dye materials belonging to the triphenylmethane class namely, bromopyrogallol red and pyrocatechol violet were investigated. Molecular orbital calculations and contour plot have indicated that the LUMO level is localized on the Ti(IV) ion, whereas the HOMO level is centered around the ligand. Moving from wet cell, i.e. using I^-/I_3^- as the redox mediator to p-type solid semiconductor CuI reduces the photo-current conversion efficiency approx. 38%. Good stability for photo-current and photo-voltage were noticed when the incident light path was intercepted using UV and IR filters. Scanning electron microscopic data have revealed that particle sizes are in the range of 50–100 nm for the CuI and 10–25 nm for the deposited colloidal TiO_2 respectively.

Keywords: Dye sensitization; Photochemical cells; Titanium dioxide; Bromopyrogallol red; Pyrocatechol violet