Comparative Analysis of Photodegradation in Ru-N3 Sensitized Wet and Solid TiO_2 Based Nanostructured Solar Cells

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Photocurrent imaging of dye sensitisation solar cells (liquid electrolyte: acetonitrile: I^-/I_3 ; solid electrolyte: CuI ; dye: cis-Ru(2,2,-bipyridyl-4,4,-dicarboxylato acid)$_2$(SCN)$_2$) exposed to simulated and selectively transmitted solar light for prologed periods revealed that solid state sensitization solar cells[1] (TiO_2 / N3 / CuI) are photochemically significantly more instable than wet cells[2] (TiO_2 / N3 / I^-/I_3^-). While wet cells may typically photodeteriorate by 15-25% during illumination periods of 800 and 1200 hours, solid state cells may photodegradate by 80% within 60-100 hours. Since development of solid state dye sensitization cells is generally accompanied by the hope for better stability, the reasons for this surprising behavior has been investigated in some detail.

While photodegradation in wet cells is determined by following reactions of the oxidized sensitizer, which are critically influenced by the chemistry of the adsorption site concerned, the photodegradation in solid cells is determined by the reverse reaction of the injected electrons with the Cu^+ of the CuI phase which can be reduced to the metallic state. The respective mechanisms are discussed, as well as strategies to overcome the photodegradation problem.

1) P. Sirimanne, T. Jeranko, P. Bogdanoff, S. Fiechter, H. Tributsch, submitted
2) B. Macht, A. Barkschat, K. Ellmer, H. Tributsch, PCCP, submitted, Poster at IPS-14, Sapporo