

Dyes and electrolytes for dye-sensitized solar cells (DSSCs) investigate with Scanning electrochemical microscopy (SECM)

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The recent interest in dye-sensitized solar cells (DSSCs) as valid alternative to common green energy sources is pushing researchers around the world to better understand the mechanism of these inexpensive solar-to electrical energy conversion devices. DSSC technology involves a redox shuttle as regenerator of the photo-oxidized dye adsorbed on the photoanode. A relevant aspect in the dye regeneration efficiency is the advantageous match between the HOMO/LUMO dye system and the reduction potential of the shuttle, which results in more positive open circuit potential V_{oc} . The combination of the semiconductor such as TiO_2 or ZnO , the dye and the mediator can be optimized to increase the overall DSSC efficiency and paves the way for further investigation of a wide variety of components.

Loss DSSCs processes, such as the hindrance of mass transport by the steric mediator in the sensitized network, are analyzed with scanning electrochemical microscopy (SECM) [1-3] and common electrochemical techniques. The dependence of diffusion on the porosity of mesoporous film and thickness is evaluated for different redox couples commonly involved as DSSC redox shuttles. The trend of the heterogeneous rate constant for the mediator regeneration is collected over an optimized set of samples and provides information about the limits of the dye regeneration and the effect of injected electrons recombination from the conductive band of the semiconductor by the oxidized form of the mediator. In this work, all-organic class of dyes well known in literature, for instance DN216 and D358, are adsorbed on the photoanodes to ensure lasting and stable sensitization of the cell. Several shuttles such as cobalt complexes [4], I^-/I_3^- [5] and others, are involved as SECM redox couples in different electrolytes. The efficiency of the mediator as dye-regenerator is tested on samples with different recombination resistance which includes screen printed TiO_2 layers, nanostructured ZnO and electrodeposited mesoporous ZnO with different porosity and thickness.

References

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