Optimization of Photocathode for Tandem-Dye Solar Cell

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Tandem dye sensitized solar cells(DSSCs) is a modification of n-type DSSCs, and could be a new device for increasing the efficiency of solar cells by converting more of the solar spectrum than can be obtained by one photoelectrode alone. The solar device is composed by two electrodes which are sensitized with two different and complimentary dyes that collect lower energy photons on one electrode and higher energy photons on the other [1].

NiO oxide is used as p-type semiconductor, and the sensitizers is anchoring on it; under irradiation, the sensitizer is excited and decays by hole injection into the VB of the NiO, forming a charge separated state. A redox couple, in most cases an iodine/triiodide couple, reacts with the charge sensitizer to regenerate the fundamental state and transports the electron to the counter electrode. The Open-Circuit Photovoltage(Voc) is the difference between the potential of the redox couple and the NiO Fermi Level.

The efficiency of tandem solar cells is limited by the p-type photocathode and the higher efficiency reached until now is 1.3% [2]. The most restriction in this case is the recombination process between the hole in the NiO to reduced dye, that limits photocurrent, and the recombination to electrolyte.

So, in order to have an efficient device, the dye regeneration and the charge injection into NiO must be able to compete with recombination.

In this research we test new sensitizers: one based on boron-dipyrromethene and a cationic acceptor dye for application in tandem DSSCs [3]; in particular we focused the attention on the optimization of the NiO p-DSSC.

We also study the influence of co-adsorbents in order to limit the aggregation and the recombination process.

References:

1) F. Odobel, Y. Pellegrin, E. A. Gibson, A. Hagfeldt, A. L. Smeigh, L. Hammarström, *Coord. Chem. Rev*., **2012**, 256, 2414-2423.
2) S. Powar, T. Daeneke, M. T. Ma, D. Fu, N. W. Duffy, G. Götz, M. Weidelener, A. Mishra, P. Bäuerle, L. Spiccia, U. Bach, *Angew. Chem*. Int. Ed., **2013**, 52, 602-605.