Chapter 10
Bondonic Electrochemistry:
Basic Concepts and Sustainable Prospects

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ABSTRACT

The main concepts of electrochemistry are reviewed in a fundamental manner as well for the applicative approach of asymmetric currents in the galvanic cells; the whole electrochemical process is eventually combined with embedded the bondonic chemistry modeling the electronic charge transfer sensitizing the anode electrode and the overall photovoltaic effect through the electrolyte fulfilling the red-ox closed circuit; the resulted bondonic electrochemistry may be suited for integration with the fresh approach of sensitization of the solar cells by the bonding quantum dots (the bondots), see the preceding chapter of the same book, towards a bondonic-bondotic photo-electrochemical integrated and cost-effective photo-current conversion; it may be used as well as for laser-based technique in controlling the electrochemical effects with optical lattices acting towards condensing the electrons into bondons and controlling them thereof.

INTRODUCTION

In the photovoltaic area, the dye sensitized solar cells (DSSCs) are becoming the most appealing renewable photo-energy sources to their low cost production and medium purity materials (O'Regan & Grätzel, 1991; Kamat, 2007). The alternative, quantum dot sensitized solar cells (QDSSCs) use the quantum dots (QDs) such as CdS, CdSe, PbS and InP compounds instead of the dye molecules (Lin et al. 2007;

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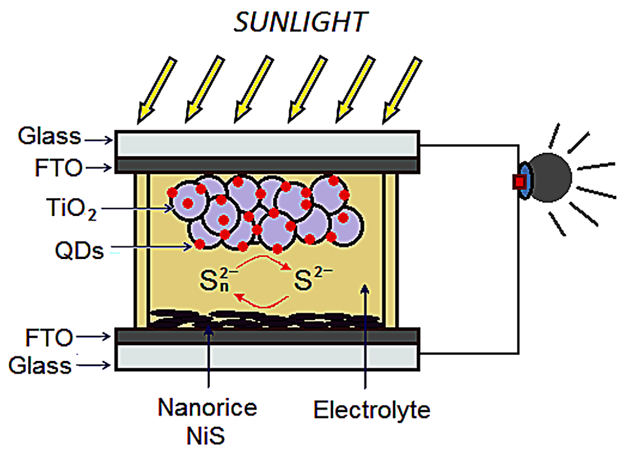
Figure 1. Schematic representation of a TiO_2/CdS/CdSe/ZnS QDSSCs structure based on nanorice sized Ni (counter electrode)
Redrawn and adapted from Kim, H. J. et al. (2014).



Prabakar el al. 2010; Acharya et al. 2010; Micic el al. 1998). As for the deposition method, these studies determined that the chemical bath deposition (CBD) represent the most commune tool used for metal sulfide, chalcogenite and oxide thin films (Kim et al. 2014).

Going to present some of recent photo-electrochemical achievements, a nanorice structured *NiS* counter electrode (CE) may be fabricated using CBD method, and based on urea or urea/triethanolamine (TEA) at different deposition time; this new regent, i.e. urea, can increase the concentration of S^{-2} ions by increasing the rate of thioacetamide (TAA) decomposition, and may be used to design a TiO_2/CdS/CdSe/ZnS QDSSCs, see Figure 1 (Kim et al. 2014).

Results show that the power conversion efficiency can be controlled by the CE active materials on FTO substrate (Grau & Akinc, 1997), such that by the adhesion of NiS thin film on FTO substrate, one can observe a long-term stability in a polysulfide electrolyte.

A custom parameter to be considered in photo-electrochemistry is the exchange current density $\left(J_o\right)$, calculated using the Tafel equation (Wu et al. 2012; Wang et al. 2009):

$$J_o = \frac{RT}{nFR_{ct}} \tag{1}$$

with

R - The gas constant,
T - The temperature,
n - The number of electrons involved in the disulfide reaction at the counter electrode,
F - The Faraday constant and
R_{ct} - The charge transfer resistance obtained from the electrochemical impedance spectroscopy (EIS) spectra at the CE/electrolyte interface.