Solar Power: Water Splitting Electrodes and DSSC/PVCC Devices

Abstract

Solar energy conversion in solar fuels or electricity is one of the most interesting and fascinating topics of the international research. Several kinds of materials and devices are designed and studied to increase the conversion efficiency of the sun energy.

Water splitting is considered an effective way for the green-production of hydrogen and hematite (α-Fe_2O_3) is an iron oxide with photocatalytic properties, used as photoanode, involved into water splitting process for oxygen evolution. The properties of hematite electrodes, produced by a low temperature method in solution, will be discussed. The interpretation of the phenomena at electrode/electrolyte interface is a crucial point in the photoelectrochemical (PEC) devices improvement. The effects of different kinds of cocatalysts (Ni, Co and Al), with particular attention to NiOOH, and different chemical deposition methods (photodeposition vs. elettrodeposition) are analysed by cyclic voltammetry and electrochemical impedance measurements.

Other topic is related to DSSCs (Dye Sensitized Solar Cells) and PVCCs (Photo-Volta-Chromic Cells), photovoltaic devices with attractive properties for building integration. The latter device can be imaged as the implementation of an electrochromic window in a DSSC and have the important properties of producing electric energy and of tuning the window transparency. Basically, the photoanode consists of titania (TiO_2) electrode where a dye is adsorbed; the counter electrode consists of platinum, necessary for the electrolyte reduction, and of tungsten oxide (WO_3), where lithium ions are intercalated producing colour changing. Recently, I proposed new configurations for this device and I'll provide a description of the work mechanisms. Finally, I'll talk briefly of alternative counter electrodes based on vertically aligned carbon nanotube composite for flexible DSSC.