Fabrication and Characterization of Dye-Sensitized Solar Cells Using Solid Materials to Replace the Liquid Electrolyte

Brian O'Regan,[1] Jeannette Wienke[1] and Frank Lenzmann[1]

[1] Energy Research Center Netherlands
Westerduinweg 3
Petten 1755 ZG
Netherlands

Dye-sensitized photoelectrochemical (DSPEC) solar cells are one of the interesting applications of nano-structured electrodes. In the last few years significant progress has been made in creating "solid-state" versions of dye-sensitized cells For these cells, the challenge is to find appropriate materials, and methods of depositing these materials in the pores of nano-structured electrodes. One approach is to use a p-type semiconductor or a molecular hole conductor to create a dye-sensitized heterojunction (DSH). The maximum efficiency of DSH cells ($<3\%$) is still significantly less than that of DSPEC cells ($\sim 10\%$). It is interesting therefore to characterize the loss routes (mainly recombination) in both kinds of cells. Characterization of dye-sensitized cells requires understanding the surface charge (of adsorbed ions), the density and occupancy of electronic states, charge diffusion in the nanostructure and in the electrolyte (or solid), and electronic "back reaction" rates. A comparison of these parameters for DSPEC cells and DSH cells formed with p-CuSCN will be made. The odds that p-CuSCN DSH cells could reach 10% if optimized will be discussed.