Characterization of Dye-sensitized Solar Cells Fabricated by Compression

Gerrit Boschloo[1], Petra Cameron[2], Anders Hagfeldt[1]
Joanna Harries[2] Eva Magnusson[1] and Laurence Peter[2]

1. Angström Solar Center, University of Uppsala, S-75121 Uppsala, Sweden.
2. Department of Chemistry, University of Bath, Bath BA2 7AY, United Kingdom

Recently, a novel low cost room temperature method has been developed for manufacturing nanostructured porous layers of TiO_2 on a conducting glass substrate for use in dye-sensitized photoelectrochemical cells[1]. The method involves coating a suspension of commercially available titanium dioxide particles onto a conducting substrate and compression of the particle layer at room temperature to form a mechanically stable, electrically conducting, and porous nanostructured film.

Dye-sensitized cells have been fabricated on conducting glass substrates by this method, using different pressures. The cells have been characterized by measurement of their performance under solar irradiation, as well as by a range of other physical methods. IPCE spectra have been measured for front and rear illumination, and the intensity dependence at the maximum in the IPCE has been studied as a function of intensity and illumination geometry.

Electron transport in the cells has been characterized by intensity modulated photocurrent spectroscopy and pulsed laser photocurrent transients over a range of illumination intensities. The back reaction of electrons with tri-iodide has been examined using intensity modulated photovoltage spectroscopy and pulsed laser induced photovoltage transients. The intensity dependence of the electron diffusion length has been estimated from the data obtained, and the results have been used to model the cell behavior to compare it with the experimentally observed performance.

A charge extraction technique has been used to relate the decay of the open circuit voltage in the dark to the distribution of electrons in traps and the kinetics of the back reaction of electrons with tri-iodide at the TiO_2 and SnO_2(F) interfaces.

The results obtained in this study have been compared with those obtained for cells fabricated by the conventional route, which involves high temperature sintering. It is clear that the low temperature method yields cells that can compete with those produced by the normal route.

1. Lindstrom, H.; Magnusson, E.; Holmberg, A.; Sodergren, S.; Lindquist, S. E.; Hagfeldt, A. *Sol. Energy Mater. Sol. Cells*, 73 91-101 (2002)