

# **An Approach towards Low-cost, Robust, Large Area Dye sensitized Solar Cell (DSSC)**

Larissa Grinis, Snir Dor, Shay Yahav, Arie Zaban

*Department of Chemistry, Institute of Nanotechnology and Advanced Materials, Bar-Ilan University, Ramat Gan, 52900, Israel*

The work presented here aims at solving some basic problems which limit the application of dye-sensitized solar cells (DSSCs): 1) Cell stability due to the presence of a volatile and corrosive electrolyte; 2) Efficient current collection in large area cells; 3) Interfacial charge recombination; and 4) Utilization of commercially available nanocrystals in the fabrication of efficient nanoporous semiconductor electrodes.

1) Iodine is highly volatile, corrosive and toxic component. It is highly preferable to use an iodine-free electrolyte. We are developing iodine-free solidified electrolytes. At present, the photovoltaic efficiency of conductive glass based DSSCs having the area of  $0.635 \text{ cm}^2$  at 1 sun (AM 1.5) illumination with the new electrolyte reached 5.2%. Long term stability tests are now in progress.

2) Scaling up the total device area leads to problems related to efficient current collection. In order to minimize internal resistive losses in a DSSC module, interconnects should be applied in series connections or as current collectors. A design with a current collector grid is preferable as it permits to increase the active area. The prevailing material for producing the current collecting grid at present is silver deposited by screen printing. Silver undergoes rapid corrosion in the presence of iodine-containing redox electrolyte and has to be protected by using high quality polymer- or glass-based protecting layers without pinholes. Our current collecting grid consists of substantially more corrosion resistant material, and it is deposited, preferable, electrochemically.

3) Suppression of the interfacial charge recombination was achieved by application of an interfacial blocking layer – a very thin overlayer of insulators or higher band gap semiconductors deposited by cathodic sol-gel electrophoretic deposition (EPD). The HRTEM images showed high conformality and uniformity of the deposited layers. The improvement in DSSC performance was found for  $\text{TiO}_2$ ,  $\text{MgO}$  and double shell overlayer  $\text{TiO}_2$ -  $\text{MgO}$ .

4) For the formation of nanoporous electrodes of DSSCs we use cathodic EPD of commercially available  $\text{TiO}_2$  nanocrystals (P-25 and P-90, Degussa) and mechanical compression. We obtained uniform, adherent  $\text{TiO}_2$  films with a thickness up to  $25 \mu\text{m}$ . The photoelectric conversion efficiency reaches 8.5% for conductive glass electrodes and 4.9% for ITO/PET conductive plastic with a standard liquid electrolyte under 1 sun (AM 1.5) illumination. The developed method is highly reproducible, and it is especially useful for the comparison of DSSC components: dyes, electrolytes and counter-electrodes.