

Polymer sensitised quasi solid-sate photovoltaic cells

J M R C Fernando and G K R Senadeera*
Institute of Fundamental studies, Kandy

Ruthenium based dye-sensitised solar cells (DSCs) have been reported to have high energy conversion efficiencies reaching 10% and are one of the promising candidates for next-generation solar cells. Apart from expensive ruthenium dyes, DSCs contain redox species (I^-/I_3^-) and volatile organic solvents such as acetonitrile. Because of their high volatilities, solvent losses occur during long-term operations, which decrease DSC performances. On the other hand, due to the high cost and the long-term unavailability of the ruthenium dyes, many research efforts have focused on

improving this system by developing new sensitisers. In this context, conducting polymers (CPs) are a versatile replacement for both the liquid electrolyte and the dye, since they can be synthesised to suit a wide range of technological purposes and are generally inexpensive. Keeping these in mind, substituted thiophene sensitised, nanocrystalline TiO₂-based quasi solid-state solar cells were fabricated either by using poly(3-thiophene acetic acid) (P3TAA) or a co-polymer; poly(3-thiophene acetic acid)-poly(hexyl thiophene) (P3TAA-PHT) polymers and copper iodide (CuI) as a hole conducting material together with the ionic liquid 1-ethyl-3-methylimidazolium bis (trifluoromethylsulfonyl) amide and lithium bis (trifluoromethanesulfone) imide as additives for charge transport promotion. Dramatic enhancements in the cell performances were observed with the additives in CuI. While the cell sensitised with P3TAA generated a short-circuit photocurrent of ~ 1.45 mA cm⁻², an open-circuit photovoltage of ~ 345 mV with a total power conversion efficiency of ~ 0.3 % under simulated full sunlight of 100 mW cm⁻² (Air Mass 1.5) the cell sensitised with copolymer P3TAA-PHT delivered ~ 0.25% efficiency under the same conditions with ~ 1.23 mA cm⁻² as photocurrent and ~ 371 mV as photovoltage.

National Science Foundation of Sri Lanka for financial assistance (Research Grant RG/2004/P/04) is acknowledged.

* rsenana@ifs.ac.lk

Tel: 081-2232002