

Photovoltaic cells using regioregular thiophenes and TiO₂

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Polymer sensitized, nanocrystalline TiO₂ photoelectrochemical cells were fabricated using regioregular conducting polymers based on poly 3-thiophene acetic acid (P3TAA). Monomers of 3-thiophene acetic acid (3TAA), thiophene malonic acid (TMA), thiophene (T) and pyrrole (PY) were used as starting materials to obtain their regioregular polymers. The photocells were able to generate reasonably high photocurrent, which increases in the presence of the electron donating ionic liquids in the electrolyte composed of redox couple I₃/I⁻. Dramatic enhancements in the cell performances were observed with the addition of ionic liquid 1-methyl-3-n hexylimidazolium iodide in to the electrolyte. While the cell sensitized with P3TAA generated a short-circuit photocurrent of ~ 4.35 mA cm⁻², an open-circuit photovoltage of ~ 472 mV and a total power conversion efficiency of ~ 1.2% under simulated full sunlight of 100 mW cm⁻² (Air Mass 1.5), the cell sensitized with regioregular polymer P3TAA-PTMA delivered ~ 3.29 mA cm⁻² as photocurrent and ~ 407 mV as photovoltage with ~ 0.8% efficiency under the same conditions. The corresponding values of the cells fabricated with either P3TAA-PT or P3TAA-PPY were 2.1 mA cm⁻², ~ 307 mV, 0.4 % and 1.45 mA cm⁻², ~ 310 mV, 0.23 %.

Key words : Conducting polymer dyes, Nanocrystalline TiO₂, Dye sensitized solar cells.

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