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Enhancement of Short-Circuit Current Density in Solar Cells via Reducing Recombination

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Bulk hetero junction (BHJ) polymer solar cells (PSCs) are one of the most promising fields as alternative energy source. Especially, the development of new p-type conjugated polymer is one of the main issues to get core technology. In this study, a series of varied ratio of 3,6-carbazole in poly[9-(heptadecan-9-yl)-9H-carbazole-2,7-diyl-alt-(5,6-bis-(octyloxy)-4,7-di(thiophen-2-yl)benzo-[1,2,5]-thia-diazole)-5,5-diyl] were designed and synthesized. These polymers have good solubility and film formability than PCDTBT which is well known promising material. Investigation of the photovoltaic properties of these new polymers indicated that polymer with 2% of 3,6-carbazole provided higher PCE (3.8% to 4.9%) with enhanced JSC, FF, VOC. We found origin of this improvement using several methods, one of which is reduced bimolecular recombination in polymer.

Keywords: recombination, carbazole

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Improving Power Conversion Efficiency and Long-term Stability Using a Multifunctional Network Polymer Membrane Electrolyte; A Novel Quasi-solid State Dye-sensitized Solar Cell

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There are many efforts to improving the power conversion efficiencies (PCEs) of dye-sensitized solar cells (DSCs). Although DSCs have a low production cost, their low PCE and low thermal stability have limited commercial applications. This study describes the preparation of a novel multifunctional polymer gel electrolyte in which a cross-linking polymerization reaction is used to encapsulate TiO_2 nanoparticles toward improving the power conversion efficiency and long-term stability of a quasi-solid state DSC. A series of liquid junction dye-sensitized solar cells (DSCs) was fabricated based on polymer membrane encapsulated dye-sensitized TiO_2 nanoparticles, prepared using a surface-induced cross-linking polymerization reaction, to investigate the dependence of the solar cell performance on the encapsulating membrane layer thickness. The ion conductivity decreased as the membrane thickness increased; however, the long term-stability of the devices improved with increasing membrane thickness. Nanoparticles encapsulated in a thick membrane (ca. 37 nm), obtained using a 90 min polymerization time, exhibited excellent pore filling among TiO_2 particles. This nanoparticle layer was used to fabricate a thin-layered, quasi-solid state DSC. The thick membrane prevented short-circuit paths from forming between the counter and the TiO_2 electrode, thereby reducing the minimum necessary electrode separation distance. The quasi-solid state DSC yielded a high power conversion efficiency (7.6/8.1%) and excellent stability during heating at 65^{o}C over 30 days. These performance characteristics were superior to those obtained from a conventional DSC (7.5/3.5%) prepared using a TiO_2 active layer with the same thickness. The reduced electrode separation distance shortened the charge transport pathways, which compensated for the reduced ion conductivity in the polymer gel electrolyte. Excellent pore filling on the TiO_2 particles minimized the exposure of the dye to the liquid and reduced dye detachment.

Keywords: Dye-sensitized solar cell. quasi-solid state. A multifunctional network polymer membrane. power conversion efficiency. long-term stability