Azide-Induced Crosslinking of Electrolytes and its Application in Solid-State Dye-Sensitized Solar Cells

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Poly(ethylene glycol) containing terminal azide groups, i.e. PEG-N_3, was synthesized by reacting poly(ethylene glycol diglycidyl ether) (PEGDGE) with NaN_3, as confirmed by ^{1}H-NMR and FT-IR spectroscopy. The resultant PEG-N_3 was complexed with LiI or ionic liquid (1-methyl-3-propylimidazolium iodide, MPII) and then crosslinked under UV irradiation to enhance the mechanical properties of the electrolytes. The ionic conductivity of electrolytes with MPII reached 1.6×10^{-5} S/cm at 25°C, which is ten-fold higher than that of electrolytes with LI (1.5×10^{-6} S/cm), due to different chain mobility. A worm-like morphology of the TiO_2 nanoporous layer was observed in the FE-SEM micrographs, which resulted from the interfacial contact between the TiO_2 nanoparticles and the electrolytes. Dye-sensitized solar cells (DSSCs) employing electrolytes with MPII and LiI exhibited an energy conversion efficiency at 100 mW/cm^2 of 1.6 % and 0.8 %, respectively. Solar cell performances were further improved by up to 4.2 % with careful optimization.