Ionic Liquid Crystal for Iodine-Free Solid-State Dye-sensitized Solar Cells

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Ionic liquid crystal (ILC) was synthesized and used as a solid electrolyte in I2-free solid-state dye-sensitized solar cells (ssDSSCs). Two ILCs, 1-[(4-ethenylphenyl) methyl]-3-butyl-imidazolium iodide (EBII) with a single aliphatic C=C bond and 1-[(4-ethenylphenyl)methyl]-3-vinyl-imidazolium iodide (EVII) with two aliphatic C=C bonds, were prepared and evaluated. The properties of the ILCs were characterized utilizing Ultraviolet - visible spectroscopy (UV-vis), X-ray diffraction (XRD), and differential scanning calorimetry (DSC) analyses verifying that EBII exhibited weaker π-π stacking interactions, longer d-spacing, and a lower melting temperature than EVII. The energy conversion efficiency of iodine-free ssDSSC with EBII (4.7% at 100 mW/cm2) was higher than with EVII (3.8%) due to facile charge transport and lower electron recombination in the former, as supported by electrochemical impedance spectroscopy (EIS).