Polypyrrole- and polyaniline-surface modified Nano silica as quasisolid state electrolyte ingredients for dye-sensitized solar cells

ABSTRACT

Polyurethane nanocomposites were formulated to entrap liquid electrolyte for quasi-solid-state electrolytes (QSEs) in dyesensitized solar cells (DSSCs). Polypyrrole- and polyaniline-surface engineered silica nanoparticles (NPs) were each incorporated to form polyurethane nanocomposites. The formation of nanosilica and its surface modification, as well as the size, aggregation, and isoelectric point of the synthesized NPs were analyzed using ATR-FTIR, TEM, and DLS. In addition, the filler (silica)–matrix (polyurethane) interaction, NP distribution, surface morphology, surface porosity, and the thermal stability of the polyurethane nanocomposite were analyzed by ATR-FTIR, transmitted and reflected light microscopes, ImageJ, and TGA. The polymer matrix absorptivity, conductivity, and ion diffusion of the polyurethane nanocomposite-based QSE was investigated by using a digital analytical balance, the AC impedance method, and the cyclic voltammetry. Lastly, all of the formulated QSEs were applied in DSSCs and their photovoltaic performance was measured. The QSE based on polyaniline surface engineered nanosilica demonstrated the highest light-to-energy conversion efficiency, namely 3.10%, with an open circuit voltage of 715 mV, a short circuit current of 3.88 mA cm−2, and a fill factor of 0.67. A reasonable lifespan stability was also found for 100 min illumination and a corresponding efficiency of 2.47% obtained.