Effect of incorporating different polyaniline-surface modified nanosilica content into polyurethane-based quasi-solid-state electrolyte for dye-sensitized solar cells

ABSTRACT

Polyaniline-surface modified nanosilica (S-PANi) was incorporated into polyurethane (PU) to form a polymer matrix able to entrap liquid electrolyte and to function as a quasi-solid state electrolyte (QSE) in dye-sensitized solar cells (DSSCs). Nanosilica was first synthesized via sol–gel technique and was post modified with aniline to form S-PANi. The effects of introducing different S-PANi content (5, 10, 15, and 20 wt%) on the nanoparticle distribution, surface morphology, surface porosity, thermal stability, and the structure of the PU matrix were analyzed using transmitted and reflected light microscopes, TGA and X-ray powder diffraction. Additionally, polymer matrix absorptivity, conductivity, and ion diffusion of the formulated QSEs were investigated by using a digital analytical balance, the AC impedance method, and cyclic voltammetry. Lastly, all of the formulated quasi-solid-state electrolytes were applied for use in DSSCs wherein their charge recombination, photovoltaic performance, and lifespan were measured. The quasi-solid-state electrolyte based on 15 wt% S-PANi (PU-15%S-PANi) exhibited the highest light-to-energy conversion efficiency, namely 3.17%, with an open circuit voltage of 708 mV, a short circuit current of 4.13 mA cm^{-2}, and a fill factor of 0.65.