Electrostatically Assembled Nickel Sulfide Nanoparticles for Pt-free Counter Electrode of Dye-sensitized Solar Cells

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In this study, we synthesized nickel sulfide nanoparticles with two different atomic ratios and morphologies via wet-chemistry for the application to Pt-free counter electrode of dye-sensitized solar cells (DSSCs). EDX analysis shows that Ni_3S_2 and NiS were successfully synthesized. Zeta potential of NiS was + 28.4mV in ethanol solution which is much higher than the Ni_3S_2 (+ 11.3mV). Nickel sulfide nanoparticles (NiS) with highly positive surface charge more effectively attached to the negatively charged FTO glass via electrostatic interaction than that of Ni_3S_2. As a result, loading of NiS nanoparticles (0.02mg cm^{-2}) was almost two-fold greater than that of Ni_3S_2(0.01mg cm^{-2}). Moreover, the processing temperature (200°C) of nickel sulfide is much lower than that of Pt (450°C), which enables the use of flexible substrates, which are preferred for quasi-solid-state dye-sensitized solar cells (qssDSSCs). The qssDSSCs fabricated with NiS displayed higher efficiency (6.8%) than that of a conventional Pt electrode(5.8%).