

Composite Films with TiO₂ Nanoparticles, TiO₂ Nanotubes, and Ag Nanoparticles for Dye-Sensitized Solar Cells

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Dye-sensitized solar cells (DSSCs) have been widely studied because of their benefits, e.g., they have an excellent price/performance ratio, low process costs, and they are lightweight. However, the efficiency of DSSCs is still relatively low. In this study, DSSCs were fabricated with three-composite films, consisting of TiO₂ nanoparticles, TiO₂ nanotubes for better electron transport, and Ag nanoparticles to achieve a plasmonic enhancement that improves the energy conversion efficiency. The prepared DSSCs with the three-composite films exhibit an efficiency enhancement of 18.86% when compared to one that includes a film with only TiO₂ nanoparticles. Furthermore, when using two-composite films, consisting of TiO₂ nanoparticles and TiO₂ nanotubes, an efficiency enhancement of 7.54% is achieved compared to a DSSC with a film consisting of only TiO₂ nanoparticles. Finally, a DSSC based on a three-composite film that comprises additional Ag nanoparticles exhibits an energy conversion efficiency enhancement of 10.52% compared to the device that comprises two composites inside the film.

Key words: Dye-sensitized solar cells, Anodization, TiO₂ nanotube arrays, Plasmonic,