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Improvement of light scattering capacity in dye-sensitized solar cells by doping with SiO_2 nanoparticles

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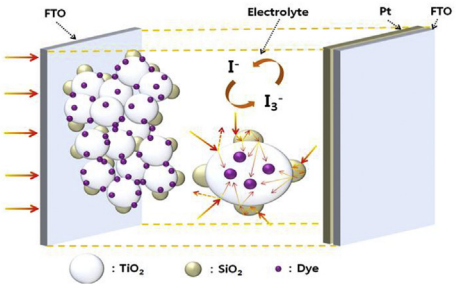
HIGHLIGHTS

- Addition of SiO_2 enhanced charge transfer and reduced charge recombination.
- Addition of SiO_2 and N supplied high surface and strong absorption of light.
- The highest power conversion efficiency was 8.68%.
- This efficiency was increased about 49.7% in comparison to TiO_2.

GRAPHICAL ABSTRACT



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ABSTRACT

N-doped TiO_2 was further doped with SiO_2 to prepare SiO_2/N-doped TiO_2 photoelectrodes with high activity in the visible region. A sol-gel process was employed to produce nanoparticles of SiO_2/N-doped TiO_2. The addition of SiO_2 to the metal oxide enhanced charge transfer and reduced charge recombination. With the addition of sufficient amounts of SiO_2 and N, the photoelectrodes exhibited a high surface area and strong absorption of light because of their altered absorptivity in the visible wavelength region. These characteristics enabled the production of photoelectrodes with increased charge transfer and reduced charge recombination, resulting in dye-sensitized solar cells (DSSCs) with enhanced J_{sc} values. The SiO_2/N-doped TiO_2 photoelectrodes were characterized using a range of analysis techniques. After the *J-V* curve measurements, the DSSCs fabricated with the 0.1 mM SiO_2/N-doped TiO_2 photoelectrodes exhibited the highest energy conversion efficiency of 8.68%, which was approximately 3% higher than that of the N-doped TiO_2 control groups. This high energy efficiency with the addition of SiO_2 might be due to the enhanced surface area of the photoelectrodes, allowing more dye absorption, and a decrease in electron recombination.

1. Introduction

In 1991, Grätzel et al. introduced dye sensitized solar cells (DSSCs), which are composed of photoelectrodes, counter electrodes, dyes, and electrolytes. The electric power is generated by

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