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Synthesis and characterization of Er^{3+} - Yb^{3+} doped ZnO upconversion nanoparticles for solar cell application

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Abstract

Erbium (Er^{3+}) and ytterbium (Yb^{3+}) co-doped ZnO upconversion (UC) nanoparticle based phosphors is synthesized by solution-combustion method. These UC phosphors are shown a strong UC emissions at red, green and blue wavelengths with the excitation of 980 nm diode laser source. To understand the influence of $\text{ZnO}:\text{Er}^{3+}\text{-Yb}^{3+}$ UC based nanoparticles on the performance of dye sensitized solar cells (DSSCs), the UC nanoparticles are incorporated into scattering layer of titanium dioxide films in the form of composite photoanode. The power conversion efficiency (PCE) of the DSSCs is increased from 8.34 to 8.72% after incorporation of $\text{ZnO}:\text{Er}^{3+}\text{-Yb}^{3+}$ upconverting nanoparticles. This enhancement in the PCE is due to increase in the short circuit current density (J_{SC}) of 18.66 mA cm^{-2} . The enhancement in the J_{SC} is due to the infrared light harvesting from infrared into the visible region, while the PCE of reference DSSC (without up conversion layer) is obtained 8.34% with the J_{SC} of 17.89 mA cm^{-2} .

Keywords: Up conversion nanoparticles; Light harvesting; ZnO nanoparticles; Dye sensitised solar cells

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