Jordan University of Science and Technology

Photo-thermal characteristics of water-based Fe3O4@SiO2 nanofluid for solar-thermal applications

Authors: Saud Khashan, Sawsan Dagher , Salahaddin Al Omari , Nacir Tit , Emad Elnajjar , Bobby Mathew and Ali Hilal-Alnaqbi

Abstract: This work proposes and demonstrates the novel idea of using Fe3O4@SiO2 core/shell structure nanoparticles (NPs) to improve the solar thermal conversion efficiency. Magnetite (Fe3O4) NPs are synthesized by controlled co-precipitation method. Fe3O4@SiO2 NPs are prepared based on sol?gel approach, then characterized. Water-based Fe3O4@SiO2 nanofluid is prepared and used to illustrate the photo-thermal conversion characteristics of a solar collector under solar simulator. The temperature rise characteristics of the nanofluids are investigated at different heights of the solar collector, for duration of 300min, under a solar intensity of 1000 W m?2 . The experimental results show that Fe3O4@SiO2 NPs have a core/shell structure with spherical morphology and size of about 400nm. Fe3O4@SiO2/H2O nanofluid enhances the photo-thermal conversion efficiency compared with base fluid and Fe3O4/H2O nanofluid, since the silica coating improves both the thermodynamic stability of the nanofluid and the light absorption effectiveness of the NPs. At a concentration of 1mg/1ml of Fe3O4@SiO2/H2O, and with the utilization of kerosene into the solar collector, and exposure for radiation for 5min, the photo-thermal conversion efficiency has shown an enhancement at the bottom of the collector of about 32.9% compared to the base fluid.