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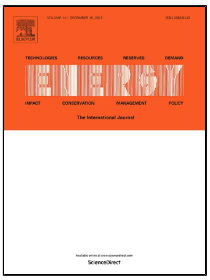

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Energy and Exergy Analysis of Nanofluid Based Photovoltaic Thermal System Integrated with Phase Change Material

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Abstract

In this study, the effects of simultaneous use of ZnO/water nanofluid with 0.2 wt% as the coolant as well as an organic paraffin wax as the phase change material (PCM) on the electrical and thermal efficiencies of a photovoltaic thermal (PVT) system are experimentally investigated. For this purpose, three different systems are studied and compared with each other: a conventional PV module, a nanofluid based PVT, and a nanofluid based PVT/PCM. The experiments are performed on selected days in August and September at the Ferdowsi University of Mashhad, Iran. The measured data are analyzed from the energy and exergy viewpoints. Based on the results, using the PCM in the nanofluid based PVT system enhances the output thermal power of the PVT system by about 29.60%. The results also indicate that the nanofluid based PVT/PCM system compared to the other two systems considered in this study (PV and nanofluid PVT) has the maximum output overall exergy and overall exergy efficiency of 114.99 W/m^2 and 13.61%, respectively. In addition, the relative reduction of the entropy generation of the nanofluid based PVT and PVT/PCM systems compared to that of the conventional PV module are about 1.59% and 3.19%, respectively.

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