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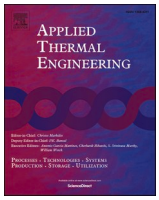

Experimental investigation of PV/T and thermoelectric systems using CNT/water nanofluids

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ABSTRACT

This study investigated experimentally the thermal performance of a Photovoltaic-thermal (PV/T) and thermoelectric (TE) system using the application of two nanofluids. Single-walled Carbon nanotube/water (SWCNT/water) and multi-walled Carbon nanotube/water (MWCNT/water), with a mass fraction of 0.02% were assessed as the working fluid of the PV/T system. Examinations were done from 10:00 to 16:30 daily in November 2021 at Tarbiat Modares University, Tehran, Iran. Different parameters were measured during the experimental tests including fluid inlet and outlet temperatures, volume flow rate, solar irradiance, and ambient and cell surface temperatures. The results showed that the highest performance of the solar system was measured using the application of SWCNT/water nanofluid. The PV/T surface temperature decreased using nanofluids compared to pure water. It was found that the output generated power and efficiency improved using nanofluid application whereas application of SWCNT/water was more effective compared to MWCNT/water nanofluid. Also, the application of the two nanofluids improved the performance of the TE module compared to pure water. The highest values of TE electric current, voltage, generated power, and efficiency were obtained using the application of SWCNT/water nanofluid.

1. Introduction

Due to the increasing world population and industrial activities, the amount of energy consumption in the world is growing daily [1]. The scarcity and depletion of fossil energy sources have increased air pollution and environmental impact causing attention to be paid to renewable energy [2]. There are several renewable energy such as solar energy, solar photovoltaic (PV) and solar-thermal, hydropower [3], wind energy, biomass, and nuclear for power generation with the least environmental impact [4].

Many researchers have investigated solar systems experimentally and/or numerically [5]. Solar PV has been introduced as a viable option for direct power generation from solar energy in recent years [6]. However, PVs do not convert a high portion of the absorbed energy to electricity, and a large amount of the absorbed energy is either reflected in the atmosphere as heat or absorbed in the cells which raise the cell temperature [7].

Since cooling solar panels with a working fluid, such as water or air [8], improves the power generation, a coolant fluid is used in the PV system by introducing Photovoltaic-thermal (PV/T) systems [9], leading to generating thermal energy and electricity simultaneously [10]. Also, the application of a TE system for cooling and generation of power in different systems such as solar PV/T is a way of performance

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