Modeling Integrated Thermoelectric Generator-Photovoltaic Thermal (TEG-PVT) System

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Abstract

Introduction
There is a demand for efficient and clean energy due to the rising cost of energy and increasing environmental awareness. Thermoelectric generation is a promising technology which cleanly converts waste heat into electricity. Solid state thermoelectric generation (TEG) modules don't have any moving parts or working fluid inside the parts and have high reliability, compact design and noiseless operation. They have been applied in aerospace applications and waste heat recovery from cars and industries [1][2][3]. Photovoltaic technology is also another clean source of energy which produces electricity from sunlight. However, the efficiency of PV decreases with PV cell temperature and they need to be cooled to maintain their efficiency by removing waste heat from the panels. The waste heat from the PV panels could be put into useful energy by using TEG. Thus, there has been researches on integrating photovoltaic cells and thermoelectric system into one hybrid generation system [4][5][6][7][8][9]. One of the problems cited in the studies was the low temperature across the TEG which minimizes the power generated by TEGs. Thus, a microfluidic heat sink based cooling system could be employed to increases the temperature range across the TEG while providing effective PV cooling. Therefore, the performance of a hybrid Photovoltaic thermal-thermoelectric generation with mini-channel liquid cooling has been studied numerically using COMSOL and the results are presented.

Use of COMSOL Multiphysics® software

A full 3 D model of thermoelectric generator, heat source PV panel and the microchannel heat sink is constructed using COMSOL Multiphysics®. The Conjugate Heat Transfer interface is used to study heat transfer and fluid flow parameters and results of temperature, velocity, pressure field are obtained. The electric current module is also used to estimate power generation from TEG module.

Reference

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