Performance of Combined PCM/Metal Foam-based Photovoltaic Thermal (PVT) Collector

ABSTRACT

Photovoltaic thermal collector (PVT) is a power generation technology that adapts solar radiation into electrical and thermal energy. There are two cooling methods in PV panels: active and passive. Phase Change Materials (PCM) have high latent heat during charging and discharging, making them promising as thermal energy storage. However, their low thermal conductivity remains a major drawback, which was to be solved by porous metal foams given their high thermal conductivity, low density, and lightness. This study aimed to introduce and analyze a novel PVT design by integrating PCM with Copper Foam Matrix (CFM) as passive cooling combined with submerged serpentine copper tubes for fluid flow as active cooling. This novel PVT was run with and without CFM by conducting a 3D steady-state simulation using COMSOL Multiphysics. This study showed that incorporating the PCM plus CFM will decrease the PV surface temperature and increase electrical efficiency. The effective thermal conductivity of PCM increased, leading to higher thermal extraction at the tested mass flow rates. At an irradiance of 1000W/m2 and an ambient temperature of 20°C, the collector achieved 65% and 13% thermal and electrical efficiency, respectively.