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Modeling and Experimental Validation of NePCM-Nanofluid-Based PVT System

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Abstract
Photovoltaic thermal (PVT) systems, when combined with nanoparticle-enhanced phase change materials (NePCM-nanofluid), significantly enhance energy efficiency in solar thermal applications. This study introduces a mathematical model for a nanofluid/NePCM PVT system, validated by experimental data. The model demonstrates electrical and thermal efficiencies of 14.50% and 70%, respectively, closely aligning with experimental results of 14% and 69.40%. The maximum temperatures observed are 43.1°C for glass, 42.60°C for the PV cell, 42°C for wax, and 41.8°C for the nanofluid. These findings underscore the model's accuracy and its practical potential for optimizing PVT systems in high-temperature environments.

Author Keywords
Hybrid PVT collectors; mathematical model; nanofluid; NePCM

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