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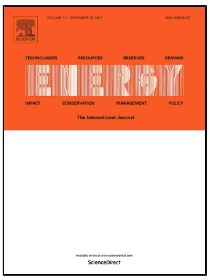

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Thermodynamic analysis for a concentrating photovoltaic-photothermochemical hybrid system

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Abstract

In this paper, a novel model of a concentrating photovoltaic-photothermochemical (CPV/PTC) hybrid system is proposed. Solar spectrum is seperated into several parts to enable photovoltaic (PV) and photothermochemical (PTC) conversion by utilizing the parabolic trough concentrator with a spectral beam splitter. The PV module converts a specific spectral range of solar radiation into electricity directly by the solar cells and the PTC module absorbs the rest solar energy to supply the reaction heat of methanol-steam reforming (MSR) that produces hydrogen for power generation. The energy and exergy analyses on the CPV/PTC hybrid system are carried out. The overall system efficiencies with different splitting wavebands, widths of the solar cells and heat transfer coefficients of the cooling system are investigated. Moreover, the CPV/PTC hybrid system is compared with a single PV or PTC system. The results indicate that the optimal splitting waveband, concentration ratio and heat transfer coefficient of the cooling system are 450nm-870nm, 7.9, and 1500 W/(m^2 · K), respectively. With the optimization of the proposed CPV/PTC hybrid system, the overall power generation efficiency can reach 25.3%.

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