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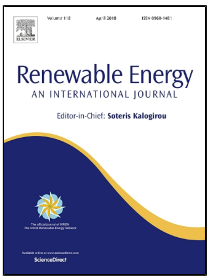

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Maximum power output and parametric choice criteria of a thermophotovoltaic cell driven by automobile exhaust

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Abstract: An unreported model of the cylindrical thermophotovoltaic cell (TPVC) composed of an emitter and a photovoltaic (PV) cell is proposed and used to recycle the waste heat released by the automobile exhaust pipe to generate electricity. To theoretically analyze the performance of this system, expressions of the power output and the conversion efficiency of the thermophotovoltaic cell driven by the automobile exhaust are derived analytically. The optimal functions of the temperature distributions of the automobile exhaust pipe and TPVC are obtained by the variational method and the modified Lagrangian formulation. The maximum power output is calculated. The performance characteristics of the whole system at the maximum power output are represented. The optimal regions of the voltage output of the PV cell, the energy gap of the material in the PV cell, and the inlet heat flow of the gas pipe are determined. The effects of the size of the gas pipe on the performance of the TPVC are discussed. The theoretical efficiencies of the TPVC and thermoelectric generator driven by the automobile exhaust are compared. The advantages of the TPVC are revealed. The results obtained show that the optimally designed TPVC can significantly harvest the waste heat of the automobile exhaust.

Keywords: Thermophotovoltaic cell; Automobile exhaust; Temperature distribution function; Maximum power output; Parametric optimization

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