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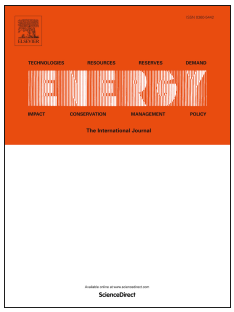

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Two-stage thermoelectric generators for waste heat recovery from solid oxide fuel cells

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Abstract: A novel hybrid system that couples a solid state two-stage thermoelectric generator (TTEG) to a solid oxide fuel cell (SOFC) is proposed to harvest the waste heat from SOFC for performance enhancement. The number of thermoelectric elements among the top and bottom stages is optimized to maximize the power output of the TTEG. A relationship between the operating current density of the SOFC and the dimensionless electric current of the optimized TTEG is derived. The operating current density interval that enables the operation of TTEG is determined. The analytical expressions for the power output and efficiency of the hybrid system are theoretically derived by considering the irreversible losses in SOFC, regenerative losses in regenerator, Joule heat and the heat-conduction losses in TTEG, and heat leakage from the SOFC to the environment. The proposed system is found to be more efficient than the stand-alone SOFC, SOFC-single stage TEG hybrid system and several other emerging SOFC-based hybrid systems. Comprehensive parametric studies are conducted to investigate the effects of operating and design parameters on the system performance. The results obtained may provide some theoretical bases for the design and operation of a real SOFC/TTEG hybrid system.

Key Words: Solid oxide fuel cell; two-stage thermoelectric generator; irreversible loss; waste heat recovery

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