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PERFORMANCE ANALYSIS FOR AN IRREVERSIBLE COMBINED THERMIONIC-THERMOELECTRIC GENERATOR WITH FINITE RATE HEAT TRANSFER

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Abstract

A model of an irreversible combined thermionic-thermoelectric generator with internal and external irreversibilities is established in this paper. The performances of the combined generator, in which the heat transfers obey radiative heat transfer law, are analyzed and optimized by using the combination of finite time thermodynamics and non-equilibrium thermodynamics. The general expressions for power output and efficiency versus drop voltage are derived. The influence of finite rate heat transfer on the performance of the combined device is extensively explored through numerical calculations. Moreover, the effects of some design parameters, i.e., the working electrical current of the thermoelectric circuit, the number of thermoelectric generating elements, and the heat sink temperature are analyzed by using detailed numerical examples. The performance of the combined generator with or without considering finite rate heat transfer is compared with that of an independent vacuum thermionic generator considering external finite rate heat transfer. The results obtained herein may provide some guidelines for the design and application of practical combined thermionic-thermoelectric generators.

Key words: combined thermionic-thermoelectric generator, finite rate heat transfer, finite time thermodynamics, performance analysis

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