

A thermoelectric power generating heat exchanger: Part II – Numerical modeling and optimization - DTU Orbit (09/11/2017)

A thermoelectric power generating heat exchanger: Part II – Numerical modeling and optimization

In Part I of this study, the performance of an experimental integrated thermoelectric generator (TEG)-heat exchanger was presented. In the current study, Part II, the obtained experimental results are compared with those predicted by a finite element (FE) model. In the simulation of the integrated TEG-heat exchanger, the thermal contact resistance between the TEG and the heat exchanger is modeled assuming either an ideal thermal contact or using a combined Cooper–Mikic–Yovanovich (CMY) and parallel plate gap formulation, which takes into account the contact pressure, roughness and hardness of the interface surfaces as well as the air gap thermal resistance at the interface. The combined CMY and parallel plate gap model is then further developed to simulate the thermal contact resistance for the case of an interface material. The numerical results show good agreement with the experimental data with an average deviation of 17% for the case without interface material and 12% in the case of including additional material at the interfaces. The model is then employed to evaluate the power production of the integrated system using different interface materials, including graphite, aluminum (Al), tin (Sn) and lead (Pb) in a form of thin foils. The numerical results show that lead foil at the interface has the best performance, with an improvement in power production of 34% compared to graphite foil. Finally, the model predicts that for a certain flow rate, increasing the parallel TEG channels for the integrated systems with 4, 8, and 12TEGs enhances the net power per TEG with average values of 2.5%, 3% and 5%, respectively. © 2016 Elsevier Ltd. All rights reserved.

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Authors: Sarhadi, A. (Intern), Bjørk, R. (Intern), Lindeburg, N. (Ekstern), Viereck, P. (Ekstern), Pryds, N. (Intern)

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