Abstract

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Simulation of a novel hot-side heat exchanger for automobile exhaust based thermoelectric generators using EFDlab

A computer simulation to predict the thermal performance of a novel hot-side heat exchanger for exhaust-based thermoelectric generators (ETEGs) has been developed. This simulation investigates the novel design features of the heat exchanger that can be represented in the implementation of copper-based alloy and innovative geometry. The simulation results can be used explicitly to calculate the output power from any implemented thermoelectric materials. A 3D model for the heat exchanger is introduced. Numerical simulation was implemented using EFDLabÂ® software package in order to predict the temperature gradient on the heat exchanger surface, as well as the in exhaust gas temperature. Several exhaust flowrate and inlet temperature values were adopted to imitate different engine operating conditions and different installation sites respectively. The simulation results were validated against the experimental results from Nissan ETEG prototype, which had comparable dimensions and flow capacity to the proposed ETEG. The results showed that the proposed ETEG has a superior performance compared to Nissan's ETEG in terms of heat exchanger effectiveness and surface temperature gradient. The present design has identified potential to be applied in small size passenger vehicles because of its relatively higher energy density, as well as its compact geometry, which can easily be retrofitted to the exhaust pipe and engine coolant circuit.