Numerical Simulation of Thermoelectric Heat Transfer Management

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Abstract—The contemporary, ever increasing power density electronics lead to more and more compact packaging for which thermal management becomes a key issue. Therefore using adequate, efficient heat removal solutions is a constant concern. Along this line, due to their advantages, there is a growing interest in utilizing solid state semiconductor devices to remove the heat and keep the electronic systems and equipment within controllable, thermally safe limits. This paper presents a mathematical model – based on the gradient (temperature, electric potential) to fluxes (heat flux and current density) relations and on the specific constitutive (material) laws – and its numerical, finite element (FEM) implementation to simulate the underlying, multiphysics processes in a TEC Peltier device. The study is aimed to provide a numerical simulation approach, of controllable accuracy, usable in the thermal design of integrated circuits in lieu of the order of magnitude analytical solutions to the heat transfer problem.