Thermoelectric Generators with Air/water Cooling and Novel Metamaterial Components

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Abstract

Extensive research efforts have been dedicated recently to developing and characterizing metamaterials that improve the performance of common thermoelectric materials and the electric contacts within a thermoelectric generator (TEG). With increasing demand for clean energy and climate change concerns, TEGs are a very appealing clean and simple option. Cooling plays a very important role as well as it is demonstrated that effective cooling can no longer extend the lifetime of a TEG but also increase its efficiency multiple times. The work presented here summarizes a number of competitive metamaterials and electrical contact options. It also presents options for efficient water cooling geometries and heat sinks. Finally, we present suggestions for optimized TEGs using the materials and cooling systems presented as a function of the thermoelectric material leg height and temperature. The work involved two undergraduate students and several more will become involved this fall in other Comsol modeling projects. Comsol has become a foundational teaching and research tool in our engineering physics program.