Use of thermal isolation to improve thermoelectric system operating efficiency

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Thermal isolation of sections of individual thermoelectric elements, modules and arrays of modules can be used to progressively heat and cool a working fluid so as to increase system efficiency when compared with that of standard TE modules with isothermal hot and cold sides. Equations for performance in heating and cooling modes are derived for steady state conditions with one-dimensional, temperature-independent material properties. Analytical approximations with closed form solutions are given for COP in cooling and heating. Results are compared with precise numerical solutions. Efficiency is shown to increase up to 120% over that of conventional TE modules for certain important applications that involve cooling or heating of a fluid or solid, such as air conditioning and heating. Limitations of the technology are also discussed. It is shown that in the particular case of steady state refrigeration usage benefit is limited or does not occur. Predicted performance of air conditioning systems using thermal isolation, in combination with advanced TE materials with ZT of 2 to 3 are shown to be comparable to refrigerant 134A.

Full Text

Bibliography:

- Best Application Paper

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