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## The effective behavior of thermoelectric composites

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### ABSTRACT

Thermoelectric materials are promising due to its capability of converting heat directly into electricity and vice versa, and can be used for both waste heat recovery and thermal management. In this study, we developed a homogenization method to study the effective behavior of thermoelectric composites with periodic microstructure. Unit cell problem is established first from asymptotic analysis, which is then solved numerically by finite element method. The effective thermoelectric properties are calculated, and the corresponding conversion efficiency is analyzed. It is discovered that the homogenized thermoelectric equations are significantly different from those of homogeneous materials. More importantly, higher conversion efficiency than those of the constituent phases is demonstrated, and the condition for improved conversion efficiency is identified. The analysis provides considerable insight into the effective behavior of thermoelectric composites, and it can be used to guide the design and optimization of high efficiency thermoelectric materials.