Evaluating Thermoelectric Properties of Graphite/Polyaniline Composites

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Transformation of waste heat into electricity can significantly contribute to a future with a wiser use of energy resources. Temperature differences can be directly converted into electricity through the Seebeck effect. An efficient thermoelectric (TE) material requires semiconductors that are good conductors of electricity but poor conductors of heat. TE materials that are efficient enough for common use are yet to be developed, since most semiconductors fail to be both good conductors of electricity and poor conductors of heat. The goal of this project was to evaluate TE properties of graphite (G)/ polyaniline (P) composites, which exhibit peak electrical conductivities at 86% and 96% G. It was hypothesized that, among various G/P composites, either the 86% or 96% G would exhibit the best TE properties because of their high electrical conductivities and mixture with the thermal insulator P. To test this hypothesis, a temperature gradient was induced on either side of the G/P composites and the voltage difference and temperature gradient were recorded. Then, the Seebeck coefficient (S) was estimated to evaluate the effectiveness of each TE material. Contrary to the hypothesis, the 100% P exhibited the best TE properties. This unexpected outcome suggests that insulating properties of TE materials may be more important than electrical conductivity, since 100% P had the lowest electrical conductivity but was the most thermally insulating. The results warrant testing other materials with varying percent compositions of thermally insulating material and highly electrically conductive materials to verify this observation. The data also supports the construction of TE modules with the tested materials.

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