4th International Symposium on
Energy Challenges & Mechanics
- working on small scales

11-13 August 2015
Aberdeen, Scotland, UK

Materials and Manufacturing Costs of Novel Thermoelectric Materials

Saniya LeBlanc[1*]

[1]*Department of Mechanical and Aerospace Engineering, The George Washington University, Washington, DC 20052, USA*

From waste-heat recovery to wearable generators, interest in thermoelectric materials and devices has flourished in recent years. Significant advances have been made in thermoelectric material performance due in large part to micro- and nano-structured bulk materials and thin films. Since questions about cost and scalability of these novel materials have remained unanswered, the commercial viability of thermoelectric devices is uncertain. This work investigates the materials and manufacturing costs as well as thermal and electrical transport factors that govern device efficiency and commercial feasibility of the most promising thermoelectric materials. The analysis includes bulk and thin film thermoelectric materials in seven material classes (chalcogenides and silicon germanium, silicides and silicon, skutterudites, half Heuslers, clathrates, oxides, and polymers) as well as novel material structures such as nanowire, superlattice, and nanostructured bulk. A thermoelectric cost-performance metric is used to evaluate candidate materials and project thermoelectric power generator costs in dollars per Watt ($/W). The results indicate the high manufacturing costs of some novel thin film materials limit their commercial feasibility. Material costs are too high for typical thermoelectric power generation applications at mean temperatures below 135 °C. Above 275 °C, many bulk thermoelectric materials can achieve costs below $1/W, and thermoelectric technologies are particularly advantageous for waste-heat recovery applications.

Keywords: thermoelectric materials, $/W, manufacturing cost