Review of Recent Progresses in Thermoelectric Materials

Jitendra Mohan Giri and Pawan Kumar Singh Nain

Abstract Thermoelectric (TE) technology facilitates the direct conversion of heat into electricity and vice versa. Thermoelectric materials attract researchers since they facilitate a promising green energy solution in the form of solid-state cooling and power generation. However, the low energy conversion efficiency restricts the use of TE materials in real-world applications. Developing highly efficient thermoelectric materials is necessary to benefit the environment as well as the economy. The performance of a particular TE material is generally evaluated by the dimensionless figure of merit (*ZT*). Recent years have witnessed progress with new techniques in maximizing the *ZT* values of various thermoelectric materials. In this review, we summarize recent development in thermoelectric materials for a specific temperature range, which has been developed to improve their maximum *ZT* value up to 95% at the same temperature.

Keywords Thermoelectric materials · Thermoelectric performance · Dimensionless figure of merit · Seebeck coefficient

1 Introduction

The environmental issues resulting from unsustainable consumption of fossil fuels are well known. Thermoelectric (TE) devices are compact, noiseless, and environmentally friendly and exhibit a leading potential for sustainable development. The thermoelectric module is a p-type and n-type semiconductor element-based solid-state device that converts the thermal energy with temperature difference into electric power (known as Seebeck effect) and also capable of converting electrical energy into temperature gradient (known as Peltier effect). Based on the directions of energy

J. M. Giri (✉) · P. K. S. Nain
Galgotias University, Greater Noida 201312, India
e-mail: jitendra.giri@galgotiasuniversity.edu.in

P. K. S. Nain
e-mail: pawan.kumar@galgotiasuniversity.edu.in

B. P. Sharma et al. (eds.), *Advances in Engineering Materials*, Lecture Notes in Mechanical Engineering, https://doi.org/10.1007/978-981-33-6029-7_26