ABSTRACT

Thermoelectric power generators require high-efficiency thermoelectric materials to transform waste heat into usable electrical energy. An efficient thermoelectric material should have high Seebeck coefficient and excellent electrical conductivity as well as low thermal conductivity. Graphene, the first truly 2D nanomaterial, exhibits unique properties which suit it for use in thermoelectric power generators, but its application in thermoelectrics is limited by the high thermal conductivity and low Seebeck coefficient resulting from its gapless spectrum. However, with the possibility of modification of graphene's band structure to enhance Seebeck coefficient and the reduction of its thermal conductivity, it is an exciting prospect for application in thermoelectric power generation. This article examines the electronic, optical, thermal, and thermoelectric properties of graphene systems. The factors that contribute to these material properties in graphene systems like charge carriers scattering mechanisms are discussed. A salient aspect of this article is a synergistic perspective on the reduction of thermal conductivity and improvement of Seebeck coefficient of graphene for a higher thermoelectric energy conversion efficiency. In this regard, the effect of graphene nanostructuring and doping, forming of structural defects, as well as graphene integration into a polymer matrix on its thermal conductivity and Seebeck coefficient is elucidated.

KEYWORDS:

- **Thermoelectric power**
- **thermal conductivity**
- **electrical conductivity**
- **energy band gap**