THERMOELECTRIC PROPERTIES OF GRAPHITE INTERCALATED COMPOUNDS

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Abstract:
During energy conversions, most of the energy is lost as heat. According to the statistical results worldwide, this amount is not less than 60%. If any part of the waste heat can be converted back to useful energy, it will certainly improve the overall efficiency of the process and contribute to reduce the energy usage. Despite current developments in the field of renewable energy, still the world is heavily dependent on fossil fuels for energy needs, causing the global climate change, as well as other indirect problems such as econo-political conflicts. Recovering the waste heat energy is as important as developing more efficient technology in power generation and distribution. Thermoelectric material can convert heat energy, especially waste heat, into electricity directly, using Seebeck effect. Development of high performance thermoelectric materials, capable of directly converting heat to electrical energy, has received attention both from energy and environment fields. A dimensionless figure of merit (ZT) is used to measure the effective thermoelectric performance of a material. Good electrical conductivity, lower thermal conductivity and high Seebeck coefficients increase the ZT value. In the recent past, the most significant materials in the field of thermoelectrics with high ZT, are Bismuth or Lead chalcogenides. Some other TE materials developed in recent years include Half-Heusler alloys, Skutterudites and caged-free Cu-based diamond like compounds, layered oxychalcogenides (i.e. BiCuSeO), SnTe-AgSbSe2 composites, Quaternary Cu2CdSnSe4 etc. However, due to low earth abundance, high material synthesis cost, toxicity etc. globally, research groups have focused their attention on developing alternative TE material. Graphite has shown promising thermoelectric properties, leading many scientists worldwide to research on graphite and graphite related material for thermoelectric applications. Graphite, having highly ordered hexagonal carbon planes bound each other by weak Van der Waals bonds, makes easy for many chemical species, known as intercalant, to intercalate between the graphite layers to form Graphite Intercalated Compounds (GICs). The electrical conductivity of GICs is much higher than that of host graphite itself due to the charge transfer occurring between the intercalated species and adjacent graphite layers. In GICs, the electrical conductivity is mainly due to the electrical carriers. Therefore increasing the carrier density, i.e. increase in the intercalate concentration leads GICs to have higher electrical conductivity Recent discoveries and trends in graphite intercalated material are discussed here with some results from the work carried out by the researcher.