# Potential of GeSbTe phase change materials for thermoelectric applications

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## ABSTRACT

Thermoelectric (TE) materials can generate electricity from low-grade waste heat. The efficiency of TE materials is determined by the dimensionless figure of merit, $ZT = S^2\sigma T/\kappa$, where $S$ is the Seebeck coefficient, $\sigma$ is the electrical conductivity, $T$ is the absolute temperature, and $\kappa$ is the thermal conductivity. Generally, $\kappa$ is considered to be the sum of lattice ($\kappa_{\rm lat}$) and electronic ($\kappa_{\rm el}$) contributions; $S$, $\sigma$, and $\kappa_{\rm el}$ are strongly interdependent, making the development of high-performance TE materials difficult. One strategy is to focus on materials with inherently low $\kappa_{\rm lat}$ values. Recently, ternary and quaternary compounds with long-period crystal structures have been attracting increasing attention. This is because such materials are expected to have low $\kappa_{\rm lat}$ values, because they have heavy constituent elements in large unit-cells and relatively weak Van der Waals bonding between their slabs; both of these characteristics lead to strong phonon scattering. Among such materials, $(GeTe)_n(Sb_2Te_3)_m$ ($n$ and $m$ are integers) materials with homologous structures are strong candidates for high-performance TE materials, because of their good electrical properties and low $\kappa_{\rm lat}$ values. In this presentation, we will introduce TE properties of polycrystalline $GeSb_6Te_{10}$. In addition, our recent trial of making a metastable cubic $Ge_2Sb_2Te_5$ bulk material as a low-temperature TE material will be introduced.

**Key words**: Thermoelectric, electrical properties, thermal conductivity, GeSbTe