Spark plasma sintering effect of $BaSnO_3$ perovskite materials for thermoelectric energy conversion application

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Abstract:

Thermal to electrical energy conversion is one of the most promising technology to produce the electricity from the unused waste heat. The major heat sources are coming out from industries, automobiles and thermal power plant. Those heat energies are largely affect environmental effects such as global warming problems. The performance of a thermoelectric(TE) material is based on the high Seebeck coefficient (S), electrical resistivity (ρ) and low thermal conductivity (κ). Non-oxide based materials such as Bi_2Te_3, PbTe and Cu_2Te are widely used for the TE application. However, these materials are easily oxidized in air and also toxic. Metal oxide-based materials are newly promising materials for the high-temperature application which has high thermal stability and low cost. In the present work Sb ions substituted $BaSnO_3$ materials were prepared with Sb: 0,5 and 10 mM by polymerization complex(PC) method and pellets of the prepared materials were made using high pressure and high temperature sintering (HPHTS) and spark plasms sintering method (SPS) at 1273 K. The synthesized materials were characterized by XRD, TEM and XPS analysis for studying their structural and morphological properties. XRD analysis revealed that the prepared materials showed that cubic structure with single crystalline structure. The thermoelectric properties of S, ρ and κ were measured as a function of temperature. The Seebeck coefficient confirmed that the conduction has n-type semiconductor. The Fig 1(a) showed the electrical resistivity as a function of temperature. The thermal conductivity was reduced from 8.2 to 4.6 W/mK SPS sintered sample Sb :10 mM as shown in Fig 1 (b). The SPS sintered sample has more grain boundary interfaces which effectively scatter the phonon thermal conductivity thereby thermoelectric properties were enhanced.

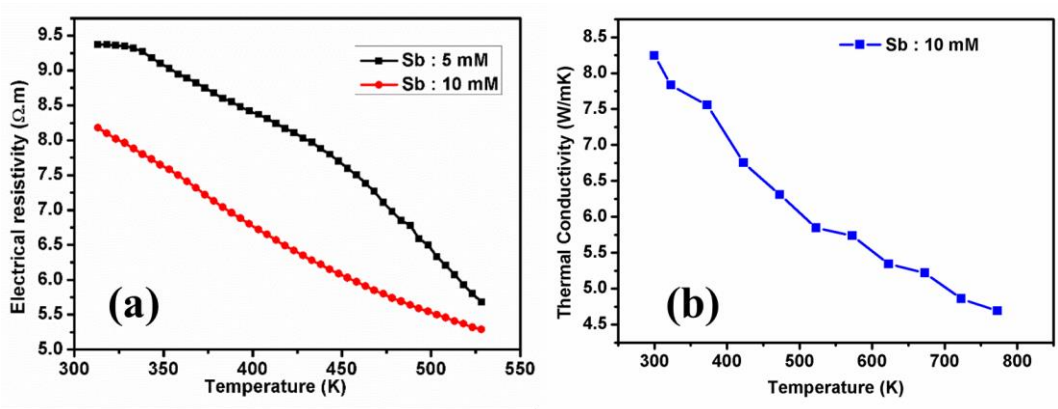

Fig 1. (a) Electrical resistivity as a function of temperature (b) Thermal conductivity

Key Words: Perovskite, Thermoelectric, Seebeck coefficient, Power factor