Influence of nanometric microstructural development on thermophysical properties of lanthanum-doped strontium titanate

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ABSTRACT

The evolution of imperfect crystal from a highly amorphous structure to an ordered crystalline structure via sintering has demonstrated a significant development onto the thermophysical properties. Therefore, a series of La-doped strontium titanate with different morphological properties have been synthesized via high energy ball milling with subsequent sintering. Doping of lanthanum tends to inhibit the grain growth where a significant reduction of grain size (range from 34 nm to 0.47 µm) could be observed. A large amount of grain boundaries presence with fine grains, resulting from lanthanum doping, has enhanced phonon scattering, thus yielding a low heat propagation in La-doped $SrTiO_3$. Besides acting as a grain growth inhibitor, lanthanum also acts as a scattering centre due to imperfection created by the doping. The scattering mechanisms significantly decrease the phonon mean free path. Consequently, the thermal diffusivity has been efficiently reduced to 1.1 mm^2/s as compared to that of pure $SrTiO_3$ which showed a value of about 3.8 mm^2/s, both observed for the complete phase polycrystalline materials. The systematic development of thermophysical and morphological properties of La-doped $SrTiO_3$ can be served as a preliminary guide to engineer thermoelectric materials with low thermal diffusivity.

KEYWORDS

Thermal diffusivity; Microstructural; Morphological; Lanthanum-doped strontium titanate

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