Effects of Synthesis and Processing on the Thermoelectric Properties of Ca₃Co₄O₉₊δ

In the present study, Ca₃Co₄O₉₊δ was synthesized by solid-state and sol-gel reactions followed by spark plasma sintering (SPS) under different conditions such as sintering temperatures, applied pressures and ramping rates. The materials were then characterized with respect to their microstructure, phase purity and thermoelectric properties. With the identical optimal SPS process, the power factor of about 400 µW/mK² and 465 µW/mK² (at 800 °C) is measured from samples produced by solid-state and sol-gel reactions respectively, both of these values are higher than the value reported so far. The thermoelectric performance improvement observed for the solid-state and sol-gel reactions suggests that the particle sizes may be a predominant key parameter of the Ca₃Co₄O₉₊δ thermoelectric properties. Smaller particle size (500 nm) as produced in this study by sol-gel synthesis method with optimal SPS process conditions would be a better way to fabricate high performance thermoelectric material Ca₃Co₄O₉₊δ.

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