Microstructure and Thermoelectric Properties of $Ca_3Co_4O_9$/SiC Thermoelectric Composites

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Thermoelectric energy conversion has received considerable attention for the production of electrical energy from waste heat. The key to realize an efficient thermoelectric generator is to develop a thermoelectric material with high thermoelectric performance and high thermal stability in air. To improve the performance of thermoelectric materials, one effective way is to increase the Seebeck coefficient and to reduce the thermal conductivity by adding nanoparticles into the matrix. In this study, $Ca_3Co_4O_9$/SiC thermoelectric compositeswith various amounts of SiC particles were fabricated by solid state reaction method. The effects of SiC particles on the microstructure and thermoelectric properties were investigated. XRD patterns, FE-SEM, and EDS were used for the characterization of crystal structure, microstructure, and composition, respectively. The transport properties were mainly discussed, based on the microstructural properties. It was found that the SiC particles were evenly distributed in the $Ca_3Co_4O_9$ matrix. Both the electrical conductivity and the Seebeck coefficient of the $Ca_3Co_4O_9$/SiC composites became larger with increasing temperature. The introduction of SiC into the $Ca_3Co_4O_9$ matrix led to a decrease in the electrical conductivity and an increase in the Seebeck coefficient. The power factor was significantly improved by the SiC addition. The thermal conductivity of the composites was suppressed by enhanced phonon scattering, improving the figure-of-merit. We believe that the introduction of SiC particles into the $Ca_3Co_4O_9$ matrix is an efficient strategy for improving thermoelectric properties.