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Microstructural control of high-temperature thermoelectric perovskite oxides for efficient energy harvesting

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Thermoelectric materials have attracted much attention owing to their potential applications in waste heat recovery, power generation and solid-state cooling. Perovskite-type oxides are considered as interesting candidates for thermoelectric renewable power generation because of their complex crystal structure, unusual magnetic and electrical properties and high chemical and thermal stability. We have synthesized $Ba_{2-x}Bi_xCoRuO_6$ ($0.0 \leq x \leq 0.8$) materials by conventional solid-state reaction method. X-ray diffraction (XRD) analysis confirmed the phase purity of all the samples. Lattice parameters and unit cell volumes calculated through Rietveld refinement of XRD patterns (Figure). TGA analysis indicated that perovskites are thermally stable and the total weight loss is about 6-7 wt.% from room temperature to 1200^0C in air. SEM micrographs showed that morphology and size of the particles change significantly with increasing Bi doping. The magnetic data revealed that double perovskites have spin glass type behavior and Neel temperature (TN) is 85K for Ba_2CoRuO_6 sample. Thermoelectric properties measured from room temperature to maximum of 700 K temperature. Seebeck coefficient (S) showed that all Ba_2-xBi_xCoRuO_6 ($0.0 \leq x \leq 0.8$) samples exhibited p-type nature of the material. Electrical resistivity decreased with increasing temperature for all the samples, indicating the semiconducting behavior of the oxide materials. The highest power factor (PF) was achieved at 670 K for $Ba_{1.2}Bi_{0.8}CoRuO_6$ compositions i.e., 3.60×10^{-2} mW/mK^2 respectively, which is many times larger than the undoped compound.

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