Asymmetric Structuring of Thermoelectric Ceramics Using Electrospun Nanoribbons

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Thermoelectricity allows direct generation of electricity from a heat flow without moving parts, which is of particular interest for recovering waste heat from industry and transportation. A significant amount of this heat is emerging from very hot surfaces. For the high-temperature range, thermoelectric materials of high thermal stability in air are required. Semiconducting cobalt oxides have been identified as promising thermoelectric materials. Among these oxides, sodium cobaltate NaxCo2O4 has outstanding thermoelectric properties, but it degrades rapidly when operated at high temperature in air. This proposal aims to utilize NaxCo2O4 by embedding it in a matrix of the air-stable thermoelectric oxide Ca3Co4O9. First, both oxides are fabricated in form of nanoribbons using electrospinning. Next, mats of these nanoribbons are pressed to green bodies and calcined at moderate temperature to provide the nanostructure. Finally, nanoribbon calcined bodies are sintered by spark-plasma sintering to facilitate densification within minutes. This fast sintering process limits grain growth and preserves the nanostructure. With the nanoribbons of both oxides being preferentially oriented parallel to each other, the final ceramic is aimed to have an asymmetric structure on the nanoscale with the NaxCo2O4 being protected from air. The main objective is the fabrication of asymmetrically structured ceramics with high loadings of NaxCo2O4 to make best use of its exceptional thermoelectric properties.

Projektbeteiligte

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