Registration number

Mechanical processing of thermoelectric materials: a solution for material texture inducing

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Abstract

Many conventional thermoelectric materials are anisotropic: the structural complexity, useful to improve the material efficiency, often leads to a strong dependence of the material properties on the different spatial direction considered. This aspect, lately subject of increasing interest, has been often neglected in the study of polycrystalline samples, because of their randomly oriented grain structure. Recently, looking for further improvements in thermoelectric efficiency, techniques for the sintering of polycrystalline samples able to preserve the natural anisotropy of the compounds have been studied and developed. The common target is to produce bulk samples easier to deal with as respect to single crystals, with improved thermal and mechanical properties, preserving the optimal electrical characteristics. In some cases, the latter depending on the crystallographic direction considered.

The present work offers a short review of the results obtained for material texture induction using different techniques, focusing on solutions involving a mechanical processing. Large space is given to the open die pressing sintering technique. The technique results to be effective in material texturing and allows to produce polycrystalline large bulks preserving the anisotropy of electrical properties (α and σ). Both structural analyses and microscopy display strong orientation of the material after sintering. In case of anisotropic materials, thermoelectric analyses performed on processed samples cut in the appropriate direction produced results comparable to the best one reported in literature.