

Severe Plastic Deformation (SPD) using High Pressure Torsion (HPT) a new route to high ZTs?

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For thermoelectric devices bulk materials with a high figure of merit ZT and high efficiencies are indispensable. Skutterudites are among the favourable materials reaching after ball milling and hot pressing ZT s of 1.2 (p-type) and 1.4 (n-type) at 800 K. For many materials lowering of the thermal conductivity via phonon scattering mechanisms has proven a key issue to increase ZT . High pressure torsion (HPT) is known as an outstanding technique to produce ultrafine grained materials under severe plastic deformation (SPD). Both p- and n-type skutterudites have been deformed by HPT with 2 - 4 GPa at room temperature and temperatures up to 500°C resulting in an oriented lamellar shaped nanograined structure with a crystallite size of about 50 nm as well as amorphous aggregates and an enhanced dislocation density. In comparison with ball milled and hot pressed skutterudites the HPT treated samples show a reduction of the thermal conductivity of about 40%. This and the slightly higher Seebeck coefficient in spite of a markedly enhanced electrical resistivity are the reason why HPT proved to enhance ZT values up to a factor 2. Vickers hardness of HPT treated p-type skutterudites was investigated showing clearly a dependence on the crystallite size.