High thermoelectric performance of n-type polycrystalline SnSe by lead alloying and halogen doping

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Thermoelectric technology enables reversible transition between heat and electric energy. Recently, single crystal SnSe materials received great attention for their high thermoelectric performance over temperature range of 773– 923 K mainly due to highly anisotropic crystal structure. Despite the high performance, extensive use of single crystal SnSe samples are limited because they are not easy to synthesize and have poor mechanical properties. Very recently, thermoelectric performance of p-type polycrystalline SnSe materials reach those of single crystal SnSe samples. However, the development of n-type polycrystalline SnSe is still challenging due to its intrinsic p-type nature. Here we present high performance n-type polycrystalline SnSe system by lead alloying and halogen doping. By optimizing alloying rate, synthesis condition and sample preparing process, we optimized electron carrier concentration of n-type SnSe system, which improves power factors. It also reduces thermal conductivities due to point defect scattering of heat-carrying phonon simultaneously. As a result, a high thermoelectric figure of merit of ~1.4 at 823 K is achieved for the optimized samples.