High thermoelectric figure of merit in n-type polycrystalline tin selenide via lead selenide alloying and cadmium doping

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A thermoelectric (TE) module is a solid state electronic device comprising n- and p-type TE materials. The TE performance of both n- and p-type TE materials is important because the worse counterpart determines the overall module efficiency. Single-crystal tin selenide is the representative TE material, showing remarkably high TE performance. However, single crystal tin selenide is difficult to commercialize due to its labor intensive production process and poor mechanical stability. Recently, TE performance of p-type polycrystalline tin selenide materials showed even greater than those of single crystal tin selenide samples. On the contrary, in the case of n-type polycrystalline tin selenide, the development is still challenging due to its intrinsic p-type nature. Here we report our synthesis of n-type polycrystalline tin selenide system by lead selenide alloying and Chlorine, cadmium co-doping. The lead selenide alloying boost carrier concentration, resulting high power factor and by optimizing cadmium concentration, lattice thermal conductivity was significantly reduced, leading to thermoelectric figure of merit (ZT) of ~1.7 at 873K for optimized sample.