Solvothermal synthesis and performance engineering of Cu2(Se,S)-based thermoelectric materials

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Superionic Cu2(Se,S)-based thermoelectric materials have drawn extensive research interest in recent years. In our study, we have synthesized Cu2(Se,S)-based thermoelectric materials via a facile solvothermal method. Through tunning synthesis condition (NaOH amount), the average Cu vacancy level of Cu2S-based thermoelectric material can be tuned, which can simultaneously change the phase transition temperature and carrier concentration leading to enhanced thermoelectric performance. Adjusting the precursor ratios could also lead to synthesis of high-purity β-Cu2Se, which has high porosity and low lattice thermal conductivity after sintering. The homogeneously doping of Ag in Cu2Se (substituting Cu) led to abnormally enhanced lattice thermal conductivity. Meanwhile, when Ag is excessing its solubility limit, additional CuAgSe secondary phase could effectively reduce the lattice thermal conductivity and enhance thermoelectric performance. Solvothermal could successfully synthesize high-purity Cu2(Se,S)-based thermoelectric materials, realize precise control of doping behaviour and tune the thermoelectric performance.