Experimental research on Thermoelectric oxide materials

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Since the discovery of the thermoelectric effect—conversion of heat into electricity based on the Seebeck effect—two hundred years ago, thermoelectricity has been remarkably developed to partially deal with the recent energy crisis around the world. Thermoelectric materials coverts the heat exhausted from vehicles, chemical/steel/coal plants, and even from the human body to generate electricity following the equation of the dimensionless figure-of-merit, $ZT = S^2\sigma T/(\kappa_l + \kappa_e)$, where S represents Seebeck coefficient, σ denotes electrical conductivity, T is the absolute temperature, $\kappa_{l,}$ and κ_e represent the lattice and electron thermal conductivity, respectively. The low efficiency is the main drawback hindering the widespread practical usage of thermoelectric devices. Several methods, such as band engineering (resonant state doping, band convergence, or quantum confinement), have been proposed to improve the efficiency, the power factor (PF = $S^2\sigma$), and structural engineering (grain refinement, introducing precipitates, and porosity design), and to reduce thermal conductivity (κ_l, and κ_e). In this talk, I will report our experimental thermoelectric results for bulk as well as thin films of ZnO and $CuCrO_2$ materials. Some challenges will be pointed out as the open questions to Computational research.