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Experimental and Theoretical Studies on Phonon Mean Free Path in Thermoelectric Materials[1]

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Nanostructured thermoelectric materials have shown improved thermoelectric figure of merit due to reduced phonon thermal conductivity. To design nanostructures that effectively scatter phonons via interface and boundary scattering, it is important to know the phonon mean free path of thermoelectric materials in their bulk form. In this talk, we will present recent progress in experimental and theoretical investigation of phonon mean free path in thermoelectric materials. On the experimental side, we extend an optical pump-and-probe technique to measure contributions of phonons with different mean free paths to thermal conductivity via systematically changing the size of the heated regions. On the theoretical side, we apply first-principle calculations to extract anharmonic force constants, and compute the phonon relaxation time due to phonon-phonon scattering. We will present experimental and theoretical results obtained on silicon, half-heuslers, etc, and their implications to thermoelectric materials.

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