Anomalous suppressed thermal conduction by electron-phonon coupling in CDW TaS2

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Charge and thermal transport in a crystal is carried by free electrons and phonons, the two most fundamental quasiparticles. Above the Debye temperature, phonon-mediated thermal conductivity is typically limited by mutual scattering of phonons, resulting in lattice thermal conductivity decreasing with inverse temperature, whereas free electrons play a negligible role. In this talk, we will discuus an unusual temperature-independent lattice thermal conductivity in charge-density-wave tantalum disulfide. From inelastic X-ray scattering measurements and first-principles calculations, it is found that the conventional phonon–phonon scattering is alleviated by its uniquely structured phonon dispersions, and unusually strong electron-phonon coupling arises from its Fermi surface strongly nested at wavevectors in which phonons exhibit Kohn anomalies. The finding reveals new physics of thermal conduction, offers a unique platform to probe electron phonon interactions, and provides potential ways to control heat flow in materials with free charge carriers.