Selective Phonon Damping in Topological Semimetals[1]

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Topological semimetals are characterized by their intriguing Fermi surfaces (FSs) such as Weyl and Dirac points, or nodal FS, and their associated surface states. Among them, topological crystalline semimetals, in the presence of strong spin-orbit coupling, possess a nodal FS protected by non-symmorphic lattice symmetries[2,3]. In particular, it was theoretically proposed that $SrIrO_3$ exhibits a bulk nodal ring[4] protected by glide symmetries, as well as flat two-dimensional surface states related to chiral and mirror symmetries[5]. However, due to the semimetallic nature of the bulk, direct observation of these surface states may be difficult. Here we study the effect of flat surface states on phonon modes for $SrIrO_3$ side surfaces. We show that mirror odd optical surface phonons are damped at the zone center, as a result of coupling to surface states with different mirror parities, while even modes are unaffected. Since this is distinct from conventional Landau damping due to the bulk, optical phonons provide a unique, surface sensitive probe. Lifetime broadening of mirror odd phonons at the zone center could be used to infer the existence of side surface states, and experimental techniques for such measurements are discussed.

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