**TERAHERTZ PERMITTIVITY OF THE BISMUTH-DOPED TOPOLOGICAL CRYSTALLINE INSULATOR Pb0.5Sn0.5Te**

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The chirality of lattice motion modes is currently one of the most active research fields in condensed matter physics. Among their many novel properties, recent studies have shown that these chiral phonons carry angular momentum and therefore couple to external magnetic fields [1]. Remarkably, their phonon magnetic moment strongly depends on electronic contributions. For example, the interplay between phonon chirality and electronic band topology was observed in Pb1-xSnxTe thin films [2]. In the topological phase (*x* > 0.32 at low temperature), epitaxial layers showed phonon magnetic moments that were several orders of magnitude larger than those in the trivial samples (*x* < 0.32). In addition to the topological phase transition, Pb1-xSnxTe undergoes a ferroelectric transition at a carrier-concentration-dependent critical temperature [2, 3]. This ferroelectric phase arises from the lattice distortion with decreasing temperature and is associated with the different degrees of phonon magnetic circular dichroism observed in those films, as broken inversion symmetry is necessary for a finite phonon angular momentum [2].

To unveiled the role of the carrier-type and concentration to the ferroelectric transition of films in the topological phase, here we studied the terahertz permittivity of a set of thin films of Pb1-xSnxTe with *x* = 0.5 doped with bismuth in the range from 0 to 0.15%, grown by molecular beam epitaxy with a thickness of 2 mm. Previous characterization reported the decrease in the as-grown hole concentration with increasing bismuth doping and the switch of the carrier type from holes to electrons at 0.06% [4]. Permittivity was measured using a home-built terahertz time-domain spectrometer in transmission geometry [5]. By recording the terahertz permittivity as a function of temperature, the softening-to-hardening change of the transverse optical phonon mode displayed the ferroelectric phase transition in all the studied samples with large doping-control of the critical temperature. Terahertz carrier and lattice dynamics were independently extracted by fitting the data with a Drude-Lorentz model, from which carrier concentration was estimated from the plasma frequency. In conclusion, our analysis showed the existence of a strong dependence of the ferroelectric transition temperature on the carrier-concentration, allowing the tuning of the ferroelectric phase in a topological crystalline insulator with bismuth doping. Our work provides a material platform for the study of chiral phonons in a system with controllable ferroelectric and topological phases.

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