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Phonon Drag in Thin Films, Cases of Bi_2Te_3 and ZnTe ¹ HANG CHI, CTIRAD UHER, University of Michigan — At low temperatures, in (semi-)conductors subjected to a thermal gradient, charge carriers (electrons and holes) are swept (dragged) by out-of-equilibrium phonons due to strong electron-phonon interaction, giving rise to a large contribution to the Seebeck coefficient called the phonon-drag effect. Such phenomenon was surprisingly observed in our recent transport study of highly mismatched alloys as potential thermoelectric materials: a significant phonon-drag thermopower reaching 1.5–2.5 mV/K was recorded for the first time in nitrogen-doped ZnTe epitaxial layers on GaAs (100). In thin films of Bi_2Te_3 , we demonstrate a spectacular influence of substrate phonons on charge carriers. We show that one can control and tune the position and magnitude of the phonon-drag peak over a wide range of temperatures by depositing thin films on substrates with vastly different Debye temperatures. Our experiments also provide a way to study the nature of the phonon spectrum in thin films, which is rarely probed but clearly important for a complete understanding of thin film properties and the interplay of the substrate and films.

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