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Plasmon-enhanced electron-phonon coupling in Dirac surface states of the thin-film topological insulator Bi_2Se_3 YURI D. GLINKA, SERCAN BABAKIRAY, DAVID LEDERMAN, West Virginia University — Raman measurements of a Fano-type surface phonon mode associated with Dirac surface states (SS) in Bi_2Se_3 topological insulator thin films allowed an unambiguous determination of the electron-phonon coupling strength in Dirac SS as a function of film thickness ranging from 2 to 40 nm. A non-monotonic enhancement of the electron-phonon coupling strength with maximum for the 8-10 nm thick films was observed. The non-monotonicity is suggested to originate from plasmon-phonon coupling which enhances electron-phonon coupling when free carrier density in Dirac SS increases with decreasing film thickness and becomes suppressed for thinnest films when anharmonic coupling between in-plane and out-of-plane phonon modes occurs. The observed about four-fold enhancement of electron-phonon coupling in Dirac SS of the 8-10 nm thick Bi_2Se_3 films with respect to the bulk samples may provide new insights into the origin of superconductivity in this-type materials and their applications.

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