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An Infrared Study of Bi2Se3 Thin Films KIRK POST, BRIAN CHAPLER, University of California - San Diego, LIANG HE, XUFENG KOU, University of California - Los Angeles, ALEX SCHAFGANS, None, KANG WANG, University of California - Los Angeles, DMITRI BASOV, University of California - San Diego — The experimental observation of surface states present in Bi_2Se_3 has been limited by self-doping via selenium vacancies. We have explored this issue by probing the electronic structure of Bi_2Se_3 using a combination of variable angle spectroscopic ellipsometry (VASE) and Fourier transform infrared spectroscopy (FTIR). Specifically, we have measured Bi_2Se_3 thin films grown on Si (111) substrates, ranging from 15 to 99 quintuple layers (QL) thick. These results show that both the carrier density and the energy gap are inversely related to the thickness. Surprisingly, the energy gap in all but the 15QL samples was smaller than the bulk band gap. Furthermore, the energy gap varied by over 100 meV between the 15QL and 99QL sample. The features that we observed are consistent with a modified picture of the band structure of Bi_2Se_3 that includes an impurity band below the conduction band and a Fermi level that is inversely related to the thickness.

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