Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Bulk Excitations in single crystal Bi_2Se_3: Electron Energy Loss Spectroscopy Study SZ-CHIAN LIOU, F.T. HUANG, R. SANKAR, M.-W. CHU, F.C. CHOU, C.H. CHEN, Center for Condensed Matter Sciences, National Taiwan University, CENTER FOR CONDENSED MATTER SCIENCES, NATIONAL TAIWAN UNIVERSITY COLLABORATION — Bi_2Se_3 with larger figure of merit has been used in room-temperature thermoelectric applications. Furthermore, it is also one of a handful known topological insulators. Most of recent studies were focused on the topological surface states of Bi_2Se_3 while few of them studied the electronic excitations of bulk Bi_2Se_3. Here, we report studies of electronic excitations of single-crystal Bi_2Se_3 by electron energy-loss spectroscopy (EELS). EELS spectrum in bulk Bi_2Se_3 reveals several spectral features at ∼7, ∼16.8, ∼26.4 and ∼28.4 eV. The peaks at ∼26.4 and ∼28.4 eV are due to excitations from Bi 5*d* electrons. The ∼7 and ∼16.8 eV peaks are easily identified as bulk-plasmon excitations according to the frequency-dependent complex dielectric function derived from experimental spectrum with Kramers-Krönig analysis. Furthermore, momentum (q)-dependent EELS spectra along [110], [300] and [001] directions were also performed in this study. When momentum transfer q is parallel [110] and [300] directions, the 16.8 eV-peak (bulk plasmon) significantly shift to higher energy (up to 23 eV) with increasing q values, while this peak shifts less than 1 eV when momentum transfer q is parallel to [001] direction, revealing the distinct anisotropy of bulk plasmon dispersions. Detailed characteristics of this anisotropic behavior will also be discussed.

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Date submitted: 05 Dec 2011 Electronic form version 1.4