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# Topological Surface State in Sb, Te, and Se Based Single Crystals

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Three-dimensional topological insulator (TI) belongs to new quantum state of matter family, which has attracted great attention over the past decade because of their unique physical properties and potential future applications [1]. TI has an energy gap in the bulk bands but has metallic topological surface states which are robust against perturbations as far as the topological properties of the energy bands are conserved. Here we report the electronic band structures of the topological insulators $Sb_2Te_3$ and $Sb_{1.9}Sn_{0.1}TeSe_2$ using angle-resolved photoemission spectroscopy (ARPES). These samples are *p*-type semiconductors and have the Dirac point inside the bulk band gap, which is favorable for dissipationless spin-based electronic devices because the scattering from the surface to bulk states is suppressed [2,3].

We have done ARPES experiments on the linear undulator beamline BL-1 [4] with the *p*-polarization geometry. We cleaved high quality $Sb_2Te_3$ and $Sb_{1.9}Sn_{0.1}TeSe_2$ single crystals in the ultrahigh vacuum to get clean surfaces. First, we did ARPES experiments changing incident photon energies to resolve the surface and bulk-derived structures. Figures 1 and 2 respectively show the ARPES intensity plots obtained from $Sb_2Te_3$ and $Sb_{1.9}Sn_{0.1}TeSe_2$ along the K-Γ-K high symmetry direction. In Fig. 1, one can clearly see the Rashba-type band splitting in $Sb_2Te_3$ around the Γ point taken at hv=25 eV at 22 K. Note that the Rashba-type band splitting was only visible for certain photon energy range and along the K-Γ-K high symmetry direction. On the other hand, in the case of $Sb_{1.9}Sn_{0.1}TeSe_2As$ in Fig. 2, the linewidth becomes broadened and we could not observe the Rashba type band splitting around the Γ point.

In the poster presentation, we will discuss the band structures of these TIs in more details.

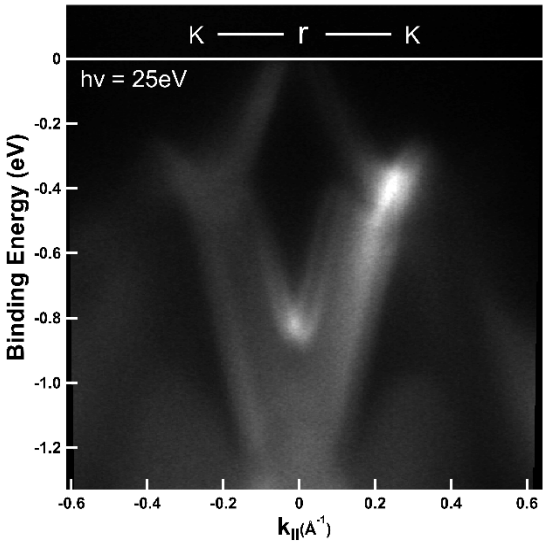


**Figure 1.** ARPES image of $Sb_2Te_3$

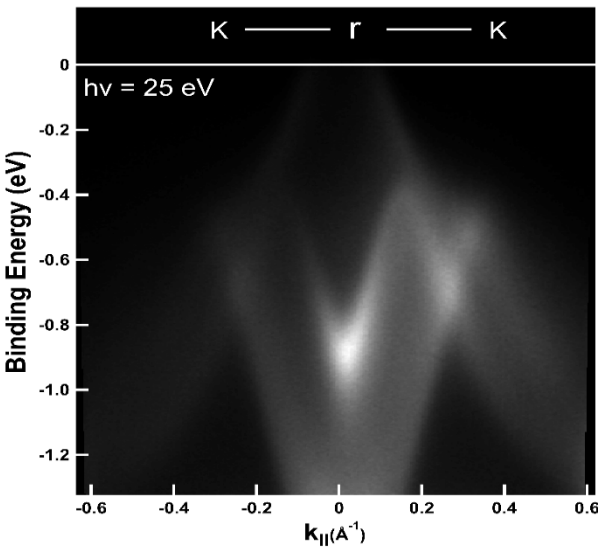


**Figure 2.** ARPES image of $Sb_{1.9}Sn_{0.1}TeSe_2$

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