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Band gap modulation in magnetically doped low-defect thin films of $(Bi_{1-x}Sb_x)_2Te_3$ with minimized bulk carrier concentration[1] YULIA MAXIMENKO, KANE SCIPIONI, ZHENYU WANG, Univ of Illinois - Urbana, FERHAT KATMIS, MIT, CHARLES STEINER, ADAM WEIS, DALE VAN HARLINGEN, VIDYA MADHAVAN, Univ of Illinois - Urbana — Topological insulators Bi_2Te_3 and Sb_2Te_3 are promising materials for electronics, but both are naturally prone to vacancies and anti-site defects that move the Fermi energy onto the bulk bands. Fabricating $(Bi_{1-x}Sb_x)_2Te_3$ (BST) with the tuned x minimizes point defects and unmasks topological surface states by reducing bulk carriers. BST thin films have shown topological surface states and quantum anomalous Hall effect. However, different studies reported variable Sb:Bi ratios used to grow an undoped BST film. Here, we develop a reliable way to grow defect-free subnanometer-flat BST thin films having the Fermi energy tuned to the Dirac point. High-resolution scanning tunneling microscopy (STM) and Landau level spectroscopy prove the importance of crystallinity and surface roughness—not only Sb:Bi ratio—for the final bulk carrier concentration. The BST thin films were doped with Cr and studied with STM with atomic resolution. Counterintuitively, Cr density is anticorrelated with the local band gap due to Cr's antiferromagnetic order. We analyze the correlations and report the relevant band gap values. Predictably, high external magnetic field compromises antiferromagnetic order, and the local band gap increases.

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