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Scanning tunneling microscopy studies of topological insulators grown by molecular beam epitaxy

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I will summarize our recent activities of using scanning tunneling microscope (STM) to study topological insulators grown by molecular beam epitaxy (MBE). The Landau quantization in three-dimensional topological insulators was directly observed in the tunneling spectra. In particular, we discovered the zeroth Landau level, which is predicted to give rise to the half-quantized Hall effect for the topological surface states. The existence of the discrete Landau levels and the suppression of Landau levels by surface impurities strongly support the 2D nature of the topological states. In addition, we studied the quantum interference pattern formed by the topological surface states near the step edges and magnetic impurities in Bi_2Se_3 and Bi_2Te_3. The decay behavior of the standing waves is in good agreement with the Dirac cone structure of the topological surface states. We show that the combination of MBE and high energy resolution scanning tunneling spectroscopy provides a powerful way to probing the novel physics in the topological insulators.