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Molecular Beam Epitaxial Growth of the Topological Insulator Bi_2Te_3
Bismuth telluride has been recently established as a simple model system for the three-dimensional topological insulator with a single Dirac cone on the surface, as determined experimentally from angle-resolved photoemission spectroscopy [1]. The conductivity measurement of the metallic surface states in Bi_2Te_3 is hindered by the bulk conductivity due to intrinsic defects, like vacancies and anti-sites. Counter doping (Ca, Sn or Pb) is a way to control the Fermi level and suppress the bulk contribution. Intrinsic conduction through topological surface states has been also obtained in very thin insulating Bi_2Te_3 epitaxial films [2]. The small lattice mismatch (< 0.04 %) to bismuth telluride makes BaF_2 (111) a suitable substrate to grow high-quality thin films. The molecular beam epitaxial (MBE) growth of Bi_2Te_3 layers on BaF_2 (111) has recently been reported using either separate Bi and Te solid sources [2] or Bi_2Te_3 and additional Te cells [3]. Depending on the growth parameters, other Bi_xTe_y phases are obtained or mixed Bi_xTe_y phases coexist in the same epitaxial film [4]. In this work, we report on a systematic study of the MBE growth of bismuth telluride films on BaF_2 (111). The substrate temperature, the Bi_2Te_3 source temperature and the additional Te flux were varied in a wide range to determine the optimum growth conditions for Bi_2Te_3 single phase films. The structural properties of the films were investigated in situ by reflection high-energy electron diffraction and ex situ by high-resolution x-ray diffraction, x-ray reflectivity, atomic force microscopy (AFM), X ray photoelectron Spectroscopy (XPS) and Angle Resolved Photoelectron Spectroscopy (ARPES). [1] Y.L. Chen et al., Science 325, 178 (2009); [2] K. Hoefer et al., PNAS 111, 14979 (2014); [3] O. Caha et al., Cryst. Growth Des. 13, 3365 (2013); [4] H. Steiner et al., J. Appl. Cryt. 47, 1889 (2014)

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Topological nonsymmorphic ribbons out of symmorphic bulk
States of matter with nontrivial topology have been classified by their bulk symmetry properties. However, by cutting the topological insulator into ribbons, the symmetry of the system is reduced. By constructing effective Hamiltonians containing the proper symmetry of the ribbon, we find that the nature of topological states is dependent on the reduced symmetry of the ribbon and the appropriate boundary conditions. We apply our model to the recently discovered two-dimensional topological crystalline insulators (TCIs) composed by IV-VI monolayers, where we verify that the edge terminations play a major role on the Dirac crossings. Particularly, we find that some bulk cuts lead to