ARPES and STM/S Study of the Cu-doped Bi2Te3 and Bi2Se3 based Topological Insulators

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Topological insulators (TI's) provide a new materials platform for the realization of novel states of quantum matter. To identify useful materials for application requires a thorough characterization of the properties of these novel systems. Single crystals of Cu-, Te- and Sb-doped Bi2Se3-based TI's have been grown using the Bridgman method. The resistivity and Hall effect were measured to check for superconductivity and determine their carrier concentrations. Two surface sensitive techniques, angle resolved photoemission (ARPES) and scanning tunneling microscopy/spectroscopy (STM/S), were then combined to study the robustness of the surface states of the TI's using the same crystals as the transport measurements. In Cu-doped Bi2Te3, quasiparticle interference scattering originating from defects was observed and the origin of the scattering processes was determined. Two types of scattering processes were found, namely (i) backscattering due to warping of the Dirac cone and (ii) backscattering between the bulk conduction band and the surface states.