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Interfacing Topological Insulators with Ferromagnetism[1]

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In topological insulators, the surface states arise from strong spin-orbit coupling while the degeneracy of the Dirac point is protected by time reversal symmetry. Introducing magnetism in proximity to the surface states breaks this symmetry, destroying the non-trivial Berry phase at the Dirac point and leads to a hedgehog spin texture near the newly opened magnetic gap.[2] This symmetry broken phase leads to a host of unusual physics, such as the quantum anomalous Hall (QAH) effect. In this talk, we discuss the growth by molecular beam epitaxy and characterization of such magnetically interfaced and magnetically doped topological insulators. Such materials often suffer from structural defects and interfacial layers, as well as from degradation during device fabrication.[3] In particular, it is shown that Cr doped $(Bi_{1-x},Sb_x)_2Te_3$ can exhibit perfect Hall quantization at low temperatures despite these defects. However, the magnetic ordering of this material was found to be quite unusual, displaying a super-paramagnetic like character, perhaps reflecting this disorder.[4] Such observations highlight the surprising behavior of such broken symmetry phases in topological materials. This work was performed in collaboration with A. Kandala, M. Liu, W. Wang, N.P. Ong, C.-X. Liu, and N. Samarth, in addition to the authors of the references cited.

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