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Magneto-optical Kerr effect in Cr-doped $(Bi,Sb)_2Te_3$ Thin Films[1]

YU PAN, BING YAO, ANTHONY RICHARDELLA, ABHINAV KANDALA, ROBERT FRALEIGH, JOON SUE LEE, NITIN SAMARTH, Dept. of Physics, Penn State University, ANDREW YEATS, DAVID D. AWSCHALOM, Institute for Molecular Engineering, University of Chicago — When a three-dimensional (3D) topological insulator (TI) is interfaced with magnetism, the breaking of time reversal symmetry results in new phenomena such as the recently observed quantum anomalous Hall effect [C.-Z. Zhang *et al., Science* **340**, 167 (2013)]. Thus motivated, we use the polar-mode magneto-optical Kerr effect (MOKE) to probe the temperature- and field-dependent magnetization in molecular beam epitaxy grown Cr-doped thin films of the 3D TI $(Bi,Sb)_2Te_3$. Square MOKE hysteresis loops observed at low temperatures indicate robust ferromagnetism with a perpendicular magnetic anisotropy and Curie temperature that varies from $\sim$ 5 K to $\sim$ 150 K, depending on sample details. A key question is the nature of the ferromagnetism: is it a carrier-mediated mechanism, Van Vleck mechanism or due to extrinsic clusters? We address this issue by varying the magnetic ion concentration and carrier density via sample composition as well as by varying the chemical potential by back gating. Finally, we use spatially-resolved MOKE to image the magnetization in these samples.

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