Strongly exchange-coupled and surface-state-modulated magnetization dynamics in Bi_2Se_3/yttrium iron garnet heterostructures

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Harnessing the spin-momentum locking of topological surface states in conjunction with magnetic materials is the first step to realize novel topological insulator-based devices. We demonstrated strong interfacial coupling in Bi2Se3/yttrium iron garnet (YIG) bilayers manifested as large interfacial in-plane magnetic anisotropy (IMA) and enhancement of damping probed by ferromagnetic resonance. The topological surface states play an important role in the magnetization dynamics of YIG. Temperature-dependent ferromagnetic resonance of Bi2Se3/YIG reveals signatures of magnetic proximity effect of T_C as high as 180 K, an emerging low-temperature perpendicular magnetic anisotropy competing the high-temperature IMA, and an increasing exchange effective field of YIG steadily increasing toward low temperature. Our study sheds light on the effects of topological insulators on magnetization dynamics, essential for the development of topological insulator-based spintronic devices.

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與清大郭瑞年教授、台大洪銘輝教授合作，本所李尚凡研究員與合作團隊研究在高品質三維拓譜絕緣體/亞鐵磁絕緣體雙層膜中，拓譜表面態與外界的交互作用。近年來，拓譜絕緣體的性質已經得到理論與實驗學家的證實。其特殊表面電子態與外界的交互作用是研究的重點。例如電子自旋-動量鎖定的特性與磁性材料磁矩間的交換耦合，即為未來器件的一個重點。我們以鐵磁共振實驗驗證了Bi2Se3/YIG($Y_3Fe_5O_{12}$)的強介面耦合，呈現面內磁異向性與增強的共振阻尼性質。在變溫測量中，可觀察到溫度180K是磁鄰近效應的居禮溫度。高溫呈現面

內磁異向性而低溫下發展出垂直磁異向性。低溫下還觀察到交換耦合造成的有效磁場增強的效應。由此清楚證明表面態對磁矩動態行為的影響。

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