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JOHANNES GUTENBERG UNIVERSITÄT MAINZ

Theory of Condensed Matter: Hard Condensed Matter

Feb. 11, 2015 at 10 a.m.
Gernot Graeff-Raum, Staudinger Weg 7, room 05-431

Binghai Yan
Max Planck Institute for Chemical Physics of Solids, Dresden

Quantum Anomalous Hall Effects on the Novel Honeycomb Material Stanene

Recently, the long-sough quantum anomalous Hall effect was realized in a magnetic topological insulator. However, the requirement of an extremely low temperature (approximately 30 mK) hinders realistic applications. Based on ab initio band structure calculations, we propose a quantum anomalous Hall platform with a large energy gap of 0.34 eV on honeycomb lattices comprised of Sn, called stanene. The ferromagnetic (FM) order forms in one sublattice of the honeycomb structure by controlling the surface functionalization rather than dilute magnetic doping, which is expected to be visualized by spin polarized STM in experiment. Strong coupling between the inherent quantum spin Hall state and ferromagnetism results in considerable exchange splitting and, consequently, an FM insulator with a large energy gap. The estimated mean-field Curie temperature is 243 K. The large energy gap and high Curie temperature indicate the feasibility of the quantum anomalous Hall effect in the near-room-temperature regions.

Refs. PRL 113, 256401 (2014); PRL 111, 136804 (2013).

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