Abstract

Spin gapless semiconductors --- an emerging quantum matter for next-generation spintronic and electronics technologies

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Spin gapless semiconductors (SGSs)-fully spin-polarized zero-gap materials, are conceptually proposed as a new class of materials with zero gap for one spin channel but a gap for the other spin channel. Depending on the energy dispersion and band configurations, there are several categories of SGS which distinct from conventional insulators, semiconductors, metals, gapless materials, magnetic materials, conventional topological insulators and metals. Due to their fascinating and unique spin, charge, and photonic states and great potential applications in electronics, spintronics, and photonics, the SGS has become one of the emerging quantum matter and there have been tremendous efforts worldwide in searching for suitable material candidates for SGSs. I will introduce the concept of the SGSs and their unique features related to spin, charge and mass. I will then highlight the Dirac type SGS as it offers an ideal platform for massless spintronics and quantum anomalous Hall effect with a dissipationless edge state. Topological SGSs with robust Dirac SGS states will also be presented. New quantum spin-dependent effects and anomalous thermoelectric effects will be discussed. Hundreds of material candidates predominately predicted by DFT will be reviewed, and new quantum theories and device applications based on the concept of SGSs will be briefly discussed. Comparisons will be made between SGSs, topological insulators, Weyl metals, Dirac semimetals, and superconductors

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