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Predicting Organic Topological Insulators in Organometallic Lattices

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Topological insulators (TIs) are a recently discovered class of materials having insulating bulk electronic states but conducting boundary states distinguished by nontrivial topology. So far, several generations of TIs have been theoretically predicted and experimentally confirmed, all based on inorganic materials. In this talk, I will present our recent study of a family of two-dimensional organic TIs made of organometallic lattices [1-4], based on first-principles calculations and tight-binding model analyses. Designed by assembling molecular building blocks of organometallic compounds with strong spin-orbit coupling into a hexagonal and Kagome lattices, these new classes of organic topological materials are shown to exhibit nontrivial topological edge states in both Dirac bands [1,4] and flat Chen bands (so-called fractional Chern insulator) [2,4], which are robust against significant lattice strain. Realization of half metallic state and anomalous quantum Hall effect in magnetic organic TIs with the inclusion of transition metal elements will also be discussed [3]. We envision that organic topological materials will greatly broaden the scientific scope and technological impact of emerging topological materials.

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[4] Z. F. Wang, N. Su and Feng Liu, "Prediction of a Two-Dimensional Organic Topological Insulator," Nano Letters, 13, 2842 (2013).