Two-dimensional topological superconductivity with Rashba type pairing in 1T'-WS_2/2H-WS_2 heterophase bilayer

Xuance Jiang,[1, 2] Yuan Ping,[3, 4] Yafis Barlas,[5] and Deyu Lu[1]
[1]Center for Functional Nanomaterials, Brookhaven National Laboratory, Upton, NY 11973, USA
[2]Department of Physics and Astronomy, Stony Brook University, Stony Brook, NY 11794, USA
[3]Department of Materials Science and Engineering,
University of Wisconsin-Madison, WI, 53706, USA
[4]Department of Physics, University of California, Santa Cruz, CA, 95064, USA
[5]Department of Physics, University of Nevada, Reno,
1664 N. Virginia Street, Reno, NV 89557, USA

Topological superconductors with Rahshba-type pairing can host fascinating electron properties, which may lead to applications in quantum information science Based on first-principles calculations, we propose a candidate system, the 1T'-WS_2/2H-WS_2 heterophase bilayer, that exhibits topological superconductivity with broken inversion symmetry. We find that the electron doping from the 2H-WS_2 layer to the 1T'-WS_2 layer creates an interface dipole and induces Rashba band splitting. The hybridization between 1T' and 2H phase shifts the valence bands and increases the Fermi density of states. Using *ab initio* calculation, we find that the electron-phonon coupling and superconductivity in heterophase bilayer is enhanced compared to monolayer. The low energy band dispersion is reproduced by a minimal six-band k·p Hamiltonian. Our work demonstrates that by exploring different combinations of transition-metal dichalcogenide materials and phases, one can achieve novel topological superconducting properties in van der Waals heterostructures of 2D materials.