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Quantum Phase Transitions in Sn Bilayer Based Interfacial Systems by an External Strain

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Using first-principle calculations, we report for the first time, the changes in electronic structures of a single bilayer Sn stacked on a single bilayer Sb (Bi) and on a single quintuple layer Sb_2Te_3 induced by both interface polarization and strain. With BL, Bi, and QL Sb_2Te_3 substrates, the stanene tends to have a low-buckled configuration, whereas with BL Sb substrate, the stanene prefers to form high-buckled configurations. For strained Sn/Sb(Bi) system, we find that the Dirac cone state is not present in the band gap, whereas in strained Sn/Sb_2Te_3 system, spin-polarized Dirac cone can be introduced into the band gap. We discuss why tensile strain can result in the Dirac cone emerging at the K point based on a tight-binding lattice model. This theoretical study implies the feasibility of realizing quantum phase transitions for Sn thin films on suitable substrates. Our findings provide an effective manner in manipulating electronic structures and topological states in interfacial systems by using interface polarization and strain, which opens a new route for realizing atomically thin spintronic devices.

Biography:

Li Chen gained her Ph.D from School of Physics, Shandong University. She worked in Institute of Condensed Matter Physics, School of Physics and Electric Engineering, Linyi University. Her major is in the area of condensed matter theory, quantum Hall effect, nanostructures and quantum devices. Her research project is on theoretical and computational studies of structural and electronic properties of electronic materials.