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Surface and electronic properties of Mn-modified $PdTe_2$ and Bi_2Te_3

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This study investigates the electronic and magnetic properties of Mn/($PdTe_2$, Bi_2Te_3) junctions, focusing on the interplay between surface phenomena and material modifications. $PdTe_2$, a superconducting semimetal with topological states and high carrier mobility, and Bi_2Te_3, a topological insulator renowned for its thermoelectric efficiency, were integrated with Mn layers to explore novel electronic and spintronic functionalities. The surface region, governed by spin-orbit coupling, plays a critical role in modulating these properties, offering potential applications in low-power electronics and advanced data storage systems.

Using Molecular Beam Epitaxy (MBE), Mn layers of varying thicknesses were deposited on single crystals of Bi_2Te_3 and $PdTe_2$. The electronic structure and surface chemistry were systematically characterized using X-ray photoelectron spectroscopy (XPS), Soft X-ray Angle- Resolved Photoelectron Spectroscopy (SX-ARPES), and X-ray Absorption Spectroscopy (XAS). Mn growth and all characterizations were obtained using PHELIX line at National Synchrotron Radiation Centre SOLARIS.

SX-ARPES measurements, performed at photon energies of 55, 70, and 100 eV, revealed significant modifications in the band structure upon Mn deposition. XPS analysis identified the formation of Te-Mn bonds and the isolation of metallic Bi, alongside subtle changes in the chemical states of Bi_2Te_3 and $PdTe_2$. Depth-resolved XPS, conducted at beam energies of 200– 1000 eV, provided insights into the layered composition. XAS spectra, acquired in Total Electron Yield (TEY) and Partial Electron Yield (PEY) modes, highlighted the surface-sensitive electronic and magnetic interactions, with a non-flat X-ray Magnetic Circular Dichroism (XMCD) signal at the Mn L edge indicating complex magnetic behavior.

These findings underscore the potential of Mn-modified telluride junctions for tailoring electronic and magnetic properties, paving the way for advancements in spintronics and low- power electronic devices.

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