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UNIVERSITÄT DUISBURG ESSEN

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Electronic Band Structure of Topological TMDCs

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Topological transition-metal dichalcogenides (TMDCs) have attracted significant research interest in recent years due to their potential applications in spintronics, optoelectronics, and quantum computation. In this talk, I will present angle-resolved photoemission spectroscopy (ARPES) studies of various topological TMDCs, including $ZrTe_2$, $ZrSe_2$, $TaTe_2$, and $TaSb_2$. ARPES studies of $ZrTe_2$ reveal free charge carriers at the Fermi level, a finding further confirmed by DFT calculations. Equal hole and electron carrier densities estimated from the ARPES data indicate that $ZrTe_2$ is a semimetal. The DFT calculations further suggest a band inversion between Te p and Zr d states at the Γ point, hinting at the nontrivial band topology in $ZrTe_2$, while $ZrSe_2$ has been found to be a semiconductor. In contrast, $TaTe_2$ exhibits a complex low-energy electronic structure arising from Fermi-surface reconstruction. Notably, its surface electronic structure resembles that of the 2H-$TaTe_2$ phase, while the bulk bands are closer to those of the hypothetical 1T-$TaTe_2$ phase. I will also present our recent ARPES results on $TaSb_2$.

Towards the end of my presentation, I will try to discuss our recent paper on the successful induction of superconductivity in the ferromagnetic layered skyrmion system Cr_3Te_4 via Sn intercalation. The resulting compound, $Sn_{0.06}Cr_3Te_4$, exhibits a superconducting phase transition at $T_c \approx 3.5$ K, where superconductivity coexists with long-range ferromagnetism and pronounced topological Hall effect. The observation of superconductivity in a skyrmion lattice brings up a new class of topological quantum materials.

[1] *Metal-chalcogen bond-length induced electronic phase transition from semiconductor to topological semimetal in ZrX_2 (X = Se and Te)*, I. Kar, Joydeep Chatterjee, Luminita Harnagea, Y. Kushnirenko, A. V. Fedorov, Deepika Shrivastava, B. Büchner, P. Mahadevan, Setti Thirupathaiah, Phys. Rev. B. **101**, 165122 (2020).
[2] *Experimental Evidence of Stable 2H Phase on the Surface of Layered 1T'-$TaTe_2$*, Indrani Kar, Kapildeb Dolui, Luminita Harnagea, Y. Kushnirenko, G. Shipunov, N. C. Plumb, M. Shi, B. Büchner, S. Thirupathaiah, J. Phys. Chem. C **125**, 1150 (2021).
[3] *$Sn_{0.06}Cr_3Te_4$: A Skyrmion Superconductor*, Shubham Purwar, Anumita Bose, Achintya Low, Satyendra Singh, R. Venkatesh, Awadhesh Narayan, and Setti Thirupathaiah, Applied Materials Today **39**, 102328 (2024).
[4] *Investigation of the Anomalous and Topological Hall Effects in Layered Monoclinic Ferromagnet $Cr_{2.76}Te_4$*, Shubham Purwar, Achintya Low, Anumita Bose, Awadhesh Narayan, S. Thirupathaiah, Physical Review Materials **7**, 094204 (2023).

Für diese Zeit steht eine Kinderbetreuung nach vorheriger Anmeldung zur Verfügung.

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