High Mobility Ternary Tetradymite Films

Hang Chi[1, 2, 3, *]

[1]*Department of Physics, University of Ottawa, Ottawa, ON K1N 6N5, Canada*
[2]*School of Electrical Engineering and Computer Science, University of Ottawa, Ottawa, ON K1N 6N5, Canada*
[3]*Nexus for Quantum Technologies, University of Ottawa, Ottawa, ON K1N 6N5, Canada*
*Email: Hang.Chi@uOttawa.ca

$(Bi,Sb)_2(Te,Se)_3$ tetradymite materials are among the most efficient for thermoelectric energy conversion, and most robust for topological insulator spintronic technologies, but should possess rather disparate doping properties to be useful for either technology. In this work [1], we report results on the molecular beam epitaxy growth of *p*-type $(Bi_{0.43}Sb_{0.57})_2Te_3$ and *n*-type $Bi_2(Te_{0.95}Se_{0.05})_3$ that can contribute to both technology bases, but are especially useful for topological insulators where low bulk doping is critical for devices to leverage the Dirac-like topological surface states. Comprehensive temperature, field and angular dependent magnetotransport measurements have attested to the superior quality of these ternary tetradymite films, displaying low carrier density on the order of 10^{18} cm^{-3} and a record high mobility exceeding 10^4 cm^2 V^{-1} s^{-1} at 2 K. The remarkable manifestation of strong Shubnikov–de Haas (SdH) quantum oscillation under 9 T at liquid helium temperatures, as well as the analyses therein, has allowed direct experimental investigation of the tetradymite electronic structure with optimized ternary alloying ratio. Our effort substantiates tetradymites as a critical platform for miniaturized thermoelectric cooling and power generation in wearable consumer electronics, as well as for futuristic topological spintronics with unprecedented magnetoelectric functionalities.

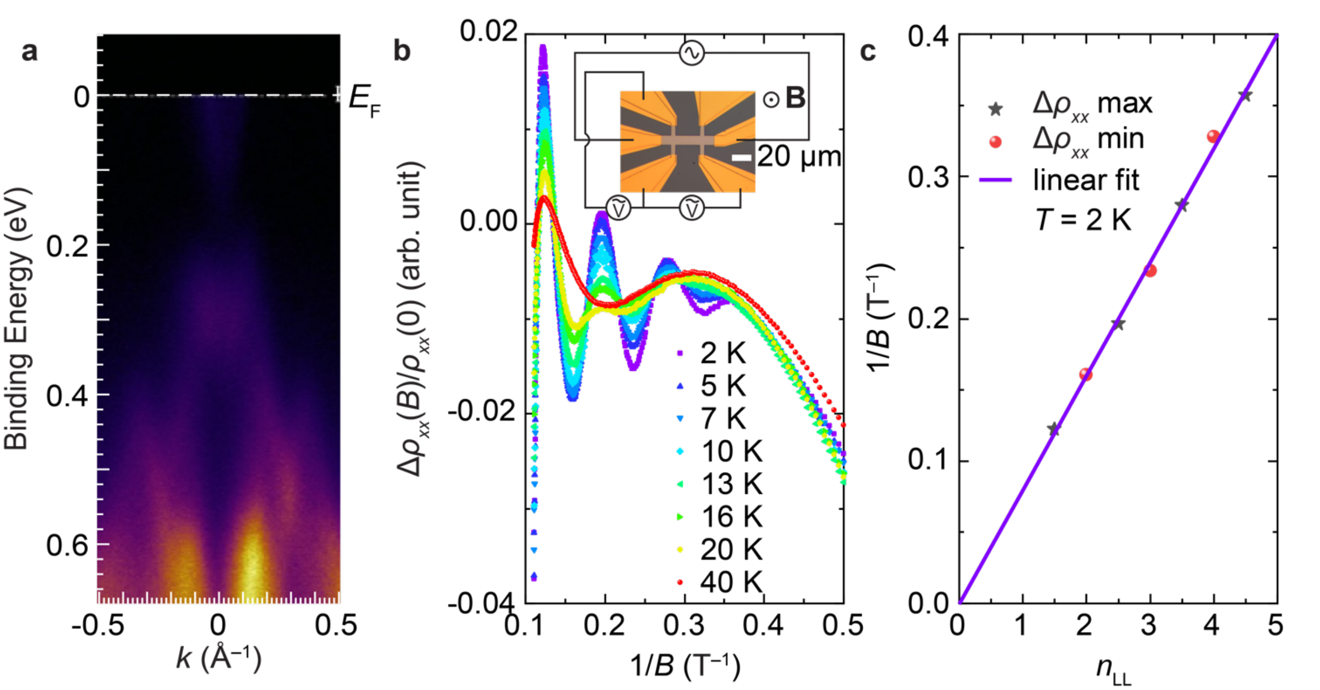

Fig. 1. (**a**) ARPES, (**b**) Shubnikov–de Haas (SdH) quantum oscillations and (**c**) Landau level index plot of *p*-type $(Bi,Sb)_2Te_3$ thin films.

Reference

[1] "Magnetotransport properties of ternary tetradymite films with high mobility", P. J. Taylor, B. L. Wooten, O. A. Vail, H. Hier, J. P. Heremans, J. S. Moodera, and H. Chi, *Materials Today Physics* 101486 (2024). https://doi.org/10.1016/j.mtphys.2024.101486