Interface Tunable Magnetism in Chromium Telluride

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Novel 2D magnets are attracting much attention recently. The MBE synthesis route is highly desirable for interface control when implementing strain engineering and/or hybridizing with other quantum systems and in overcoming the inherent scalability limitation of exfoliation. *In situ* prepared atomically sharp interfaces further enable fundamentally new phenomena, while providing opportunities in spintronics, leveraging interface-driven versatility [1]. Ferromagnetic Cr_2Te_3 ultrathin films, optimally grown on Al_2O_3(0001) and $SrTiO_3$(111), manifest an extraordinary sign reversal in the anomalous Hall conductivity as temperature and/or strain are modulated. It turns out that the nontrivial Berry curvature in the electronic-structure momentum space is responsible for this exotic behavior. This finding opens a new, strain-tunable and technological relevant platform for reciprocal-space magnetic monopoles [2]. Moreover, when proximitized with $(Bi,Sb)_2Te_3$-type topological insulator, the magnetic ordering in monolayer Cr_2Te_3 is favorably enhanced, displaying enhancement in Curie temperature owing to the Bloembergen-Rowland interaction [3]. Combining advanced scanning tunneling microscopy, magnetic force microscopy, transmission electron microscopy, depth-sensitive polarized neutron reflectometry, magnetotransport and *ab initio* simulation, Cr_2Te_3 has been established as a far-reaching platform for further investigating the *marriage of magnetism and topology, in both real and reciprocal spaces*. These findings provide new perspectives to the magnetic topological materials in general, that are topical for the future development of topological spintronics.

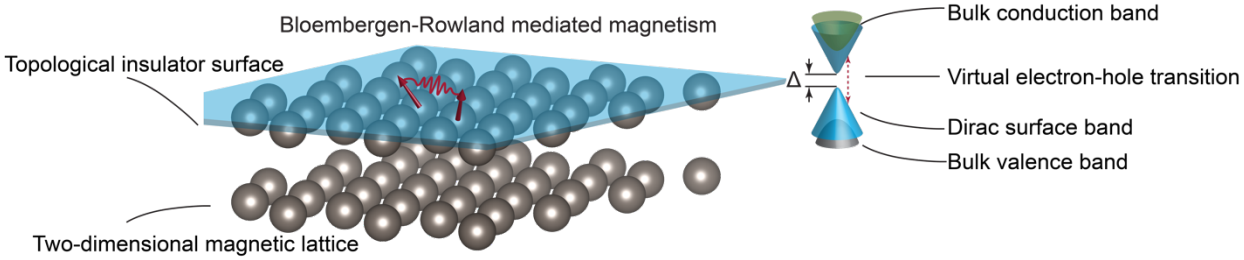

Fig. 1. Enhancing 2D magnetism via the Bloembergen-Rowland interaction in proximity with a topological insulator (TI).

References

[1] "Progress and prospects in the quantum anomalous Hall effect", H. Chi and J. S. Moodera, *APL Materials* **10**, 090903 (2022).
https://doi.org/10.1063/5.0100989

[2] "Strain-tunable Berry curvature in quasi-two-dimensional chromium telluride", H. Chi, Y. Ou, T. B. Eldred, W. Gao, S. Kwon, J. Murray, M. Dreyer, R. E. Butera, A. C. Foucher, H. Ambaye, J. Keum, A. T. Greenberg, Y. Liu, M. R. Neupane, G. J. de Coster, O. A. Vail, P. J. Taylor, P. A. Folkes, C. Rong, G. Yin, R. K. Lake, F. M. Ross, V. Lauter, D. Heiman, and J. S. Moodera, *Nature Communications* **14**, 3222 (2023).
https://doi.org/10.1038/s41467-023-38995-4

[3] "Enhanced Ferromagnetism in Monolayer Cr_2Te_3 via Topological Insulator Coupling", Y. Ou, M. Mirzhalilov, N. M. Nemes, J. L. Martinez, M. Rocci, A. Duong, A. Akey, W. Ge, D. Suri, Y. Wang, H. Ambaye, J. Keum, M. Randeria, N. Trivedi, K. S. Burch, D. C. Bell, W. Wu, D. Heiman, V. Lauter, J. S. Moodera, and H. Chi, *Physical Review Letters*, under revision, arXiv:2312.15028 (2024).
https://doi.org/10.48550/arXiv.2312.15028