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Engineering of magnetic chalcogenide interfaces guided by polarized neutron reflectometry

Significant recent effort has been devoted in understanding the geometric aspects of condensed matter [1]. The marriage of topology and magnetism at disparate quantum interfaces, guided by polarized neutron reflectometry (PNR), constitutes an exciting arena for developing novel memory, logic and information technologies. We introduce quasi-two-dimensional (2D) magnetic transition metal chalcogenide Cr2Te3 grown by molecular beam epitaxially (MBE) as an emerging platform for spin-orbit driven Berry phenomena [2]. A unique temperature/strain modulated sign reversal of the anomalous Hall effect has been discovered and attributed to nontrivial Berry curvature physics [3]. The versatile interface tunability of Cr2Te3, when hybridized with a topological insulator [4], offers new designs for topological devices [5]. Furthermore, we observe nonreciprocity in supercurrent transport and demonstrate strong field-free superconducting diode effect in magnetic insulator/superconductor bilayers [6]. These heterostructures enable new computing regime with low energy cost, mitigating Joule heating with dissipationless supercurrent, well suited for high demanding data centers. The PNR technique is ideal in advancing the understanding of magnetic surfaces and interfaces, for exciting development of topological and superconducting spintronics.

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Topical Area

Hard matter: quantum, electronic, semiconducting materials

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