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Large bandgap quantum anomalous hall insulator in a designer ferromagnet-topological insulator-ferromagnet heterostructure

Ferromagnetic insulator (FMI)/Topological insulator (TI) heterostructure is an advantageous platform for realizing Quantum Anomalous Hall effect (QAHE) and Topological Magnetoelectric effect (TME) via magnetic proximity effect. The time reversal symmetry breaking, a key ingredient for realising QAHE, is achieved by the magnetization from the FMI layer in the proximity of a TI, which opens up an exchange gap in the surface state (SS). Recently, 1 septuple layer (SL) MnBi2Te4 (MBT) has been reported to be a van der waals FMI with robust out-of-plane long-range Ferromagnetic order and is an ideal FMI for engineering such heterostructures. Combining Bi2Te3 (BT) with 1SL MBT, these two forms stable crystal structure with minimal potential barrier across the interface, enabling strong exchange interaction between SS and magnetic moments in 1SL MBT. By characterizing high-quality epitaxial thin films of 1SL MnBi2Te4 / 4QL Bi2Te3 /1SL MnBi2Te4 (MBT/BT/MBT) heterostructures using Angle Resolved Photoelectron Spectroscopy (ARPES), we have observed massive 2D Dirac Fermions with magnetic band gap of 75meV at 8K and exchange coupling induced band asymmetry consistent to the size of magnetic band gap. These results are in excellent agreement with first principle calculations. Our work has enhanced the understanding of electronic structures and proved the feasibility of engineering massive Dirac Fermions in MBT/BT/MBT heterostructures which has potential applications in spintronics and quantum computing.

Level of Expertise

Student

Presenter Gender

Man

Pronouns

He/Him

Which facility did you use for your research

Australian Synchrotron

Students Only - Are you interested in AINSE student funding

Yes

Do you wish to take part in the Student Poster Slam

No

Condition of submission

Yes

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