O 21: Poster Monday: Topology and Symmetry-Protected Materials

Time: Monday 18:00–20:00 Location: P4

O 21.1 Mon 18:00 P4

Local manifestations of thickness dependent topology and axion edge state in topological magnet $MnBi_2Te_4$ — •Felix Lüpke[1,2], Anh Pham[2], Yi-Fan Zhao[3], Ling-Jie Zhou[3], Wenchang Lu[4,5], Emil Briggs[4], Jerzy Bernholc[4,5], Marek Kolmer[2,6], Wonhee Ko[2], Cui-Zu Chang[3], Panchapakesan Ganesh[2], and An-Ping Li[2] — [1]Peter Grünberg Institut (PGI-3), Forschungszentrum Jülich, Germany — [2]Center for Nanophase Materials Sciences, Oak Ridge National Lab, USA — [3]Physics, The Pennsylvania State University, USA — [4]Physics, North Carolina State University, USA — [5]Computational Sciences and Engineering Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37916, USA — [6]Ames Laboratory, USA

The interplay of non-trivial band topology and magnetism gives rise to a series of exotic quantum phenomena, such as the emergent quantum anomalous Hall (QAH) effect. Many of these phenomena have local manifestations when the global symmetry is broken. Here, we report local signatures of the thickness dependent topology in intrinsic magnetic topological insulator $MnBi_2Te_4$ (MBT), using scanning tunneling microscopy and spectroscopy on molecular beam epitaxy grown MBT thin films. A thickness-dependent band gap with an oscillatory feature is revealed, which we reproduce with theoretical calculations. At step edges, we observe localized electronic features, in agreement with topological phase transitions across the steps.

O 21.2 Mon 18:00 P4

Electronic Structure of the Weak 3D Topological Insulator Candidate $Bi_{12}Rh_3Ag_6I_9$ — •Johannes Hessdörfer[1,2], Eduardo Carillo-Aravena[2,3], Armando Consiglio[2,4], Michael Ruck[2,3], Domenico Di Sante[5], and Friedrich Reinert[1,2] — [1]Experimentelle Physik VII, Universität Würzburg, Würzburg, Germany — [2]Würzburg-Dresden Cluster of Excellence ct.qmat, Würzburg Dresden, Germany — [3]Anorganische Chemie II, Technische Universität Dresden, Germany — [4]Theoretische Physik I, Universität Würzburg, Würzburg, Germany — [5]University of Bologna, Bologna, Italy

The electronic structure of $Bi_{12}Rh_3Ag_6I_9$, a weak topological insulator (TI) candidate, is investigated by means of angle-resolved photoelectron spectroscopy (ARPES) and density functional theory calculations. The compound consists of alternating layers of a 2D TI in a Kagome configuration, separated by insulating spacer layers. The Kagome net is formed by rhodium centered bismuth cubes, while the spacer consists of silver and iodine. The results are compared to the mother material $Bi_{14}Rh_3I_9$ [1], denoting the first experimentally observed weak TI. In particular, the influence of the silver substitution into the spacer layer and the potential modification of the coupling between the 2D TI layers is discussed.

[1]Rasche et al., Nature Mater, 12, 422-425 (2013)

O 21.3 Mon 18:00 P4

Characterisation of Fe adsorbates and their effect on the local density of states on topological insulators $TlBiSe_2$ and Bi_2Se_3 by means of combined STM/STS and AFM — •Adrian Weindl, Christoph Setescak, Alexander Liebig, and Franz J. Giessibl — University of Regensburg, Germany

Can one tailor the properties of the topological surface state (TSS) of topological insulators (TIs) by magnetic doping of the TI material? Here, we study the effect of magnetic adatoms on TI surfaces by means of combined scanning tunneling microscopy (STM) and atomic force microscopy (AFM). Two archetypical TIs, Bi_2Se_3 and $TlBiSe_2$, are studied, which both have relatively large band gaps with their Dirac points well isolated and far from bulk states. While the surface of Bi_2Se_3 is atomically flat, $TlBiSe_2$ exhibits a peculiar surface termination consisting of half a monolayer of thallium atoms sitting on top of a full selenium layer. Magnetic impurities, in this case single Fe adatoms, and their influence on the local density of states (LDOS) of the two TIs are investigated by means of scanning tunneling spectroscopy. We detect resonances in the LDOS for the Fe adatoms that arise due to the scattering of electrons in the TSS at these impurities. The position and shape of these resonances are a function of the exact adsorption position of the adatoms, which can be determined by means of atomically-resolved AFM measurements.

O 21.4 Mon 18:00 P4

Investigation of the V/TI interface by TEM and ARPES — •Xiao Hou[1], Max Vassen-Carl[2], Mohammed Qahosh[1], Xiankui Wei[3], Peter Schüffelgen[2], Claus Michael Schneider[1], and Lukasz Plucinski[1] — [1]PGI-6, Forschungszentrum Jülich, Germany — [2]PGI-9, Forschungszentrum Jülich, Germany — [3]ERC-2, Forschungszentrum Jülich, Germany

Topological insulators (TIs) can host so-called Majorana zero modes (MZM) when proximitized with superconductors (SCs). Such a TI/SC system is a promising platform for realizing fault-tolerant quantum computers by employing braiding of the Majorana zero modes [1], in which a sharp interface between SC and TI is one of the prerequisites to realize the Majorana mode [2-3]. Here, vanadium(V) - $(Bi_{0.08}Sb_{0.92})_2Te_3$ is chosen as the SC/TI system.

We use advanced transmission electron microscopy (TEM) and angle-resolved photoemission spectroscopy (APRES) to study structural and electronic properties of the V/TI interfaces. High-resolution TEM and high-angle annular dark-field imaging provide details on crystallinity and atomic arrangements associated with various types of structural defects, while the energy-dispersive X-ray spectroscopy reveals the elemental distribution and also the interfacial interdiffusion. The band alignments between TI and V are studied using ARPES on ultrathin V films deposited on vacuum-transferred TI surfaces.

[1] B. Jäck et al. Science **364**.6447 (2019). [2] P. Schüffelgen et al. Journal of crystal growth **477** (2017). [3] M. Bai et al. Physical Review Materials **4**.9 (2020).

O 21.5 Mon 18:00 P4

Heterostructure engineering with the van der Waals topological insulator Bi_2Te_3 — M. Dittmar[1,2], •E. Mantel[1,2], P. Kagerer[1,2], C. I. Fornari[1,2], H. Bentmann[1,2], and F. Reinert[1,2] — [1]Exp. Physik VII, Uni Würzburg — [2]Würzburg-Dresden Cluster of Excellence ct.qmat

Recently, combining magnetism and topology has emerged as a promising research field spanning from topological insulator (TI)-superconductor interfaces to intrinsic magnetic systems [1]. In these systems exciting new phenomena such as Majorana modes are predicted to emerge. Here we present two approaches to study these promising structures.

The first focuses on the intrinsically ferromagnetic monolayer of $MnBi_2Te_4$. In order to observe the predicted effects in this compound its Fermi level should be tuned inside the bulk band gap. Our approach to control the Fermi level position is to prepare a single layer of $MnBi_2Te_4$ on top of a p-n-junction of Sb_2Te_3 and Bi_2Te_3 grown by molecular beam epitaxy (MBE). In the second approach we investigate the preparation of thin films of the TI Bi_2Te_3 on superconductor substrates. In order to obtain more information about the crystalline structure and surface orientation, we use different characterization methods such as reflection high-energy electron diffraction, X-ray diffraction and low-energy electron diffraction. To investigate the impact on the electronic structures of these systems, angle resolved and X-ray photoemission specroscopy are employed.

[1] M.M. Otrokov et al., Nature **576** (2019)