O 34: Poster Session - Topological Insulators

Time: Monday 18:15–20:00 Location: P1C

O 34.1 Mon 18:15 P1C

Dirac-like Electrons in a Two-Dimensional Indium Layer on SiC(0001) — •Maximilian Bauernfeind[1], Jonas Erhardt[1], Philipp Eck[2], Victor Rogalev[1], Jörg Schäfer[1], Domenico Di Sante[2], Giorgio Sangiovanni[2], and Ralph Claessen[1] — [1]Physikalisches Institut and Würzburg-Dresden Cluster of Excellence ct.qmat, Universität Würzburg, Würzburg, Germany — [2]Institut für Theoretische Physik und Astrophysik and Würzburg-Dresden Cluster of Excellence ct.qmat, Universität Würzburg, Würzburg, Germany

Mono- and sub-monolayer of In deposited on semiconducting or insulating substrates show a wide range of different surface reconstructions with unique electronic configurations. So far, none of them has been demonstrating Dirac-like electrons. Here we report first experimental results of an In (1×1) phase on SiC(0001) which clearly exhibits a linear band dispersion with Dirac points at the K/K' points in the hexagonal Brillouin zone in angle-resolved photoelectron spectroscopy (ARPES). Density functional theory (DFT) gives a remarkably good agreement and predicts a topologically non-trivial gap of approximately 50 meV at the K points rendering it applicable for room temperature devices. A sensitive parameter in DFT is the bonding distance between the In layer and the substrate which determines the non-trivial topology of this system. Additionally, the stabilization of the In layer on SiC leads to the surface Rashba effect and causes a large splitting of the valence band at the K points with strong out-of-plane spin polarization as predicted by theory.

O 34.2 Mon 18:15 P1C

Domain walls as possible realization of edge state coupling in a quantum spin Hall insulator — •Raul Stühler[1], André Kowalewski[1], Felix Reis[1], Johannes Weis[1], Joerg Schaefer[1], Gang Li[2], Werner R. Hanke[1], Dimitri Jungblut[1], Benedikt Scharf[1], Fernando Dominguez Tijero[1], Ewelina M. Hankiewicz[1], and Ralph Claessen[1] — [1]Universität Würzburg, Germany — [2]ShanghaiTech University, China

The recently discovered monolayer system bismuthene/SiC(0001) is a promising candidate for the realization of a room temperature quantum spin Hall (QSH) effect. Previous experiments have established a large fundamental band gap (0.8 eV) and the existence of one-dimensional metallic edge states [1]. As expected for a QSH insulator, the electronic edge channels do not show any signs of backscattering from kinky edge sections that would manifest in interference phenomena. Notwithstanding, topological protection against defect scattering may become lifted when two helical edge channels are brought into direct proximity, resulting in quantum interference. By scanning tunneling microscopy we study phase-slip domain boundaries (DB) with limited longitudinal extent. By spectroscopic means we scrutinize quasiparticle interference along these one-dimensional topographic defects that points towards a linear electronic dispersion strongly reminiscent of a Fabry-Pérot resonator. We discuss our findings as possible quantum interference between coupled helical edge states formed in the vicinity of a DB.

[1] F. Reis et al., Science 357, 287 (2017)

O 34.3 Mon 18:15 P1C

Topographic and electronic surface characterization of Bi_2Te_3-derivatives with periodic Mn sub-lattices via STM/STS — christian salazar[1], •vladislav nagorkin[1], alexander zeugner[3], anna isaeva[1,2,3], bernd büchner[1,2], and christian hess[1] — [1]Leibniz Institute for Solid State and Materials Research, Dresden, Germany — [2]Faculty of Physics, Technische Universität Dresden, Germany — [3]Faculty of Chemistry and Food Chemistry, Technische Universität Dresden, Germany

Materials combining topological surface states and intrinsic magnetism have gained great attention due to the possibility to be a platform to host tunable topological matter. Here we characterized topographically and spectroscopically two possible candidates through scanning tunneling microscopy. The studied compounds are Bi_2Te_3-derivatives with periodic Mn sub-lattices, i.e. $MnBi_2Te_4$ and $MnBi_4Te_7$. The two sample-types are composed on the one hand by only septuple layers ($MnBi_2Te_4$), and on the other hand by alternation of Bi_2Te_3-quintuple and septuple layers ($MnBi_4Te_7$). Single crystals of the van der Waals layered materials have been cleaved in cryogenic vacuum at 5 K and subsequently measured. Different characteristic surfaces were identified and spectroscopic data for the different materials and surfaces will be discussed.

O 34.4 Mon 18:15 P1C

Macroscopic investigation of conducting Na_2IrO_3 surfaces prepared in UHV — •Máté Stark[1], Thomas Dziuba[1], Ina Pietsch[2], Philipp Gegenwart[2], and Martin Wenderoth[1] — [1]IV. Physikalisches Institut, Georg-August-Universität Göttingen, Germany — [2]Lehrstuhl für Experimentalphysik VI, Zentrum für elektronische Korrelationen und Magnetismus, Universität Augsburg, Germany

Na_2IrO_3 is a prototypical material in the honeycomb iridate family, which has also been proposed theoretically to exhibit topological protected surface states [1]. Experimental evidences for such surface states are lacking, possibly because of the high reactivity of Na_2IrO_3 in air, leading to rapid degradation of its surface. To overcome this problem we evaporated gold contacts and cleaved the crystal in UHV. We studied the electrical conductivity of the uncleaved and cleaved surface as well as of the surface after degradation in air as function of temperature between 100 K and 300 K, and compared the results with the conductivity of the bulk. The freshly cleaved crystal showed in contrast to the previously reported semiconductor-like behaviour a saturation of the sheet resistance at about 2,9 kΩ at low temperatures [2]. After the degradation of the surface in air, the conductivity of the surface decreased at low temperatures, and we measured a general change in the temperature dependence compared with the freshly cleaved surface. Conclusively we report a conducting surface on the freshly cleaved Na_2IrO_3 surface. **References**: [1] Phys. Rev. **108**, 106401 (2012), [2] Phys. Rev. **B82**, 064412 (2010)

O 34.5 Mon 18:15 P1C

Combined AFM/STM investigation of the topological insulators Bi_2Se_3 and $TlBiSe_2$ — •Adrian Weindl, Felizitas Luisa Kolb, Alexander Liebig, and Franz J. Giessibl — Institute of Experimental and Applied Physics, University of Regensburg, Universitätsstraße 31, D-93053 Regensburg, Germany

Topological insulators (TIs) are a class of materials whose bulk system is insulating, whereas the surface houses topologically-protected metallic states. This enables investigation of the surface via scanning tunneling microscopy (STM). The observed structure of the conducting surface states depends on the atomic structure of the surface and can be influenced by introduction of magnetic perturbations as demonstrated on the materials Bi_2Se_3 and Bi_2Te_3 [1,2]. After cleaving in vacuum, the surface of the TI $TlBiSe_2$ is terminated by half a monolayer of Tl atoms [3], which leads to the absence of a trivial surface state that was predicted for a completely filled Tl layer on the surface [4]. Simultaneous STM and atomic force microscopy (AFM) measurements on $TlBiSe_2$ yielded very distinct results. While in the STM images, the conducting surface states had a worm-like structure, atomic resolution of the surface atoms was possible in AFM [3]. Here, we evaporate single iron atoms onto the surfaces of Bi_2Se_3 and $TlBiSe_2$ to study the connection between surface structure, magnetic perturbations and electronic properties of TIs by a combination of AFM and STM measurements. [1] J. Honolka et al., PRB 108, 256811 (2012) [2] T. Eelbo et al., PRB 89, 104424 (2014) [3] F. Pielmeier et al., New J. Phys. 17, 023067 (2015) [4] B. Singh et al., PRB 93, 085113 (2016)

O 34.6 Mon 18:15 P1C

Photoemission Study on the Three Dimensional Topological Insulator HgTe(001) — •Julia Issing[1], Raphael Crespo Vidal[1], Lukas Lunczer[2], Lena Fürst[2], Simon Moser[3], Hartmut Buhmann[2], Laurens W. Molenkamp[2], Hendrik Bentmann[1], and Friedrich Reinert[1] — [1]Experimental Physics VII, University of Würzburg — [2]Experimental Physics III, University of Würzburg — [3]Experimental Physics IV, University of Würzburg

Mercury Telluride (HgTe) is a paradigmatic topological material that plays a key role in the exploration of topological physics in solids. For example, it is known to behave as a topological insulator under tensile strain and as a Weyl semimetal under compressive strain. In this contribution, we present the chemical and structural characterization of the (001)-surface of HgTe films grown by molecular beam epitaxy. The films are grown along the (001)-direction on a CdTe(001)-

substrate, which induces a tensile strain. By means of LEED, we studied the surface geometric structure indicating a (2x1) reconstruction. Furthermore, the chemical composition of HgTe films is examined with XPS. The topologically non-trivial electronic structure was investigated by studying the angle resolved valence-band photoemission spectra of HgTe(001) using excitation with HeI_α as well as synchrotron radiation.

O 34.7 Mon 18:15 P1C

Photoelectron spectroscopy on thin Fe(Se,Te) superconductor films on Bi-based topological insulators — •Philipp Kagerer, Thiago R. F. Peixoto, Simon Müller, Ali Aljanabi, Celso Fornari, Hendrik Bentmann, and Friedrich Reinert — Experimental Physics VII, Julius Maximilian University of Würzburg

It has been shown that the electronic properties of thin layers of Fe-based superconductors can be manipulated by the choice of the substrate material. This includes an enhancement of T_c, *e.g.* as reported on $SrTiO_3$, as well as possible novel topological phases [1,2]. Owing to its simple cubic structure and good growth properties, thin layers of Fe(Se,Te) on a Bi-based three-dimensional topological insulator (TI) pose a promising platform for the research on superconductor-TI interface systems. Here we report on the epitaxial growth and characterization of thin layers of Fe(Se,Te) on the nearly lattice matched quaternary $(Bi,Sb)_2(Se,Te)_3$ TI single-crystal. LEED and XPS experiments, as well as STM and STS measurements, confirm the formation of a few monolayers of Fe(Se,Te) on top of the TI substrate. Using ARPES, we show the arising of the FeSeTe valence bands near the Fermi level, along with the heavily n-doped band structure of the underlying TI. In addition, photon-energy-dependent and resonant measurements using synchrotron radiation allow a distinction between substrate and overlayer bands, and show indications for strong electron correlation and a Hubbard-gap in the material.

[1] Liu D.F., Nat comm 3, 931(2012)
[2]Beenakker, C.W.J., Annu. Rev. Condens. Matter. Phys., 4 (2013)

O 34.8 Mon 18:15 P1C

Scanning tunneling Microscopy on the Magnetic Topological Insulator $MnBi_2Te_4$ — •Philipp Küppers[1], Gunther Springholz[2], Oliver Rader[3], Marcus Liebmann[1], and Markus Morgenstern[1] — [1]II. Inst. Phys. B and JARA-FIT, RWTH Aachen University — [2]Institute of Semiconductor and Solid State Physics, Johannes Kepler University Linz — [3]Abteilung Materialien für grüne Spintronik, Helmholtz Zentrum Berlin

Recent angle resolved photoemission spectroscopy studies show both gapped and ungapped Dirac cones in the magnetic topological insulator $MnBi_2Te_4$ both above and below the Neil temperature.
We present scanning tunneling microscopy data on samples grown by molecular beam epitaxy. The samples have been transfered into a homebuild ultra high vacuum STM operating at 4.3K with a vacuum shuttle operating at a pressure of $1 * 10^{-10}$mbar. We observe variations in topography beyond the atomic corrugation and present quasi particle interference patterns at the energies of the Dirac cone.