HL 97: Topological Insulators II (Joint session of DS, HL O and TT, organized by HL)

Time: Friday 9:30–12:00 Location: H15

HL 97.1 Fri 9:30 H15

Signatures of induced superconductivity in a p-n heterostructure comprised of Sb_2Te_3 and Bi_2Te_3 3D topological insulator thin films with in situ Al capping — •Peter Schüffelgen[1], Daniel Rosenbach[1], Martin Lanius[1], Jörn Kampmeier[1], Gregor Mussler[1], Markus Eschbach[1], Ewa Mlynczak[1], Lukasz Plucinski[1], Martina Luysberg[1], Stefan Trellenkamp[1], Martin Stehno[2], Prosper Ngabonziza[2], Alexander Brinkman[2], Yuan Pang[3], Li Lu[3], Thomas Schäpers[1], and Detlev Grützmacher[1] — [1]Peter Grünberg Institut and JARA-FIT, Forschungszentrum Jülich, 52425 Jülich, Germany — [2]TNW and MESA+ Institute for Nanotechnology, University of Twente, 7500 AE Enschede, The Netherlands — [3]Laboratory for Solid State Quantum Information and Computation, Institute of Physics, Chinese Academy of Sciences, 100190 Beijing, China

We investigate the transport properties of Sb_2Te_3/Bi_2Te_3 p-n heterostructure topological insulator film-superconductor junctions. The films are grown by means of molecular beam epitaxy on a Si (111) substrate and capped *in-situ* by a thin layer of aluminum to prevent thin film degradation and to preserve the Dirac-like surface states. Josephson junctions are defined by depositing two niobium electrodes, separated by a few tens of nanometers, onto the Sb_2Te_3/Bi_2Te_3 layer. The transport measurements at cryogenic temperatures showed signatures of Andreev reflections and Josephson supercurrents. For wider junctions a Fraunhofer pattern was observed for the critical current, whereas for the narrow junctions a monotonous decrease was found.

HL 97.2 Fri 9:45 H15

Teraherz-Induced Chiral Edge Photogalvanic currents in 2D HgTe Topological Insulators — •Kathrin-Maria Dantscher[1], Dimitry A. Kozlov[2], Maria-Theresia Scherr[1], Sebastian Gebert[1], Vasily V. Bel'kov[3], Nikolay N. Mikhailov[2], Sergey A. Dvoretskii[2], Ze Dong Kvon[2], and Sergey D. Ganichev[1] — [1]University of Regensburg, Regensburg, Germany — [2]Institute of Semiconductor Physics, Novosibirsk, Russia — [3]Ioffe Institute, St. Petersburg, Russia

We report on the observation of a chiral photogalvanic current generated in the topological protected edge states of 2D topological insulators fabricated on the basis of 8 nm thick HgTe quantum wells. Illuminating the sample with circularly polarized terahertz radiation and picking-up the signal along the edges we detected a photocurrent whose direction reverses by switching radiation polarization from right- to left-handed one. The influence of the magnetic field, the temperature and the angle of incidence of the radiation to these photocurrents are investigated. We demonstrate that circularly polarized radiation, which, according to selection rules, excites only electrons with a certain spin, results in an imbalance of electron distribution in the k-space and causes a spin polarized electric current.

HL 97.3 Fri 10:00 H15

temperature induced shift of the chemical potential of Bi2Te2Se tetradymite topological insulators — •jayita nayak[1], gerhard h fecher[1], siham quardi[1], chandra sekhar[1], claudia felser[1], christian tusche[2], shigenori ueda[3], and eiji ikenaga[4] — [1]Max Planck Institute for Chemical Physics of Solids, Dresden — [2]Max Planck Institute of Microstructure Physics, Halle — [3]Synchrotron X-ray Station at SPring-8National Institute for Materials Science, Hyogo 679-5148, Japan — [4]Japan Synchrotron Radiation Research Institute, SPring-8, Hyogo, 679-5198, Japan

The temperature dependent HAXPES spectra of Bi2Te2Se reveal the appearance of an additional spectral feature above the band gap at low temperature. It appears at 20 K but is absent in the 300 K spectra and the onset of the main features of the spectra is shifted to lower energies. Momentum resolved photoemission electron microscopy (k-PEEM)was carried out using in order to explain the origin of the additional spectral feature. The measurement provides the evidence of the evolution of bulk bands at low temperature which is caused by the shift of the chemical potential. The bulk sensitive HAXPES valence band spectra are in perfect agreement with first principles calculations.

HL 97.4 Fri 10:15 H15

Optical investigation of the three-dimensional Dirac semimetals $CaMnBi_2$ and $SrMnBi_2$ — •Micha B. Schilling[1], Artem V. Pronin[1], Martin Dressel[1], and Youguo Shi[2] — [1]1. Physikalisches Institut, Universität Stuttgart, 70569 Stuttgart, Germany — [2]Beijing National Laboratory for Condensed Matter Physics, Institute of Physics, Chinese Academy of Sciences, 100190 Beijing, China

The interest in the measurements of optical conductivity in three-dimensional Dirac semimetals is based on the recent theoretical studies [1, 2], where the interband optical response of such systems has been shown to be very peculiar. Namely, the real part of the interband optical conductivity has been predicted to be linear in frequency with the slope being related to the Fermi velocity of Dirac electrons.

We investigated the optical properties of the three-dimensional Dirac semimetals $CaMnBi_2$ and $SrMnBi_2$ by means of Fourier-transform infrared spectroscopy. We measured the reflectivity over a frequency range from 50 to 25000 cm^{-1} at different temperatures down to 10 K and determined the optical conductivity from these measurements. In the presentation, we will discuss our results on the optical conductivity in comparison with theoretical predictions.

[1] P. Hosur, S. A. Parameswaran, and A. Vishwanath, Phys. Rev. Lett. **108**, 046602 (2012). [2] A. Bácsi and A. Virosztek, Phys. Rev. B **87**, 125425 (2013).

30 min. Coffee Break

HL 97.5 Fri 11:00 H15

Optoelectronic dynamics in nanocircuits based on the topological insulator Bi2Te2Se — •Mariana Hettich[1], Paul Seifert[1], Christoph Kastl[1], Kristina Vaklinova[2], Marko Burghard[2], and Alexander Holleitner[1] — [1]Walter Schottky Institut and Physik-Department, Technische Universität München, Am Coulombwall 4a, D-85748 Garching, Germany — [2]Max-Planck-Institut für Festkörperforschung, Heisenbergstrasse 1, D-70569 Stuttgart, Germany

We report on the optoelectronic dynamics in nanocircuits made of the topological insulator Bi2Te2Se. An on-chip photocurrent pump-probe spectroscopy based on coplanar striplines allows us to identify the different ultrafast photocurrent mechanisms in topological insulators with a picosecond time resolution. We discuss non-equilibrium thermal effects as well as the circular photogalvanic current generation as contributions to the overall photocurrent.

HL 97.6 Fri 11:15 H15

Structural Study of Weak Topological Insulator Bi_1Te_1 Films on Si(111) grown by Molecular Beam Epitaxy — •Martin Lanius[1], Markus Eschbach[1], Ewa Mlynczak[1], Jens Kellner[2], Pika Gospodaric[1], Chengwang Niu[1], Elmar Neumann[1], Martina Luysberg[3], Gregor Mussler[1], Lukasz Plucinski[1], Gustav Bihlmayer[1], Stefan Blügel[1], Markus Morgenstern[2], Claus Michael Schneider[1], and Detlev Grützmacher[1] — [1]Peter Grünberg Institut, Forschungszentrum Jülich, Germany — [2]II. Institute of Physics B and JARA-FIT, RWTH Aachen University, Aachen, Germany — [3]Ernst Ruska-Centre for Microscopy and Spectroskopy with Electrons, Forschungszentrum Jülich, Germany

We have studied the nucleation, growth process and structural composition of the weak topological insulator Bi_1Te_1 on Si(111) substrates by STM and STEM. Bi_1Te_1 is a superlattice of predicted 2D topological insulating materials, one bilayer Bi and two Bi_2Te_3 quintuple layers per unit cell. The van der Waals growth mode of Bi_1Te_1 shows smooth surfaces and a supressed twin domain density. The thin films from several nanometers thickness down to the nucleation regime have been grown by molecular beam epitaxy. STEM measurements of the grown films reveal a high crystalline perfection. Simulations and ARPES measurements show 2D surface states originating from spin-orbit coupling, depending in their structure on the surface termination. Furthermore we will demonstrate the ability to grow n-p heterostructures of n-doped Bi_1Te_1 with the p-doped strong TI Sb_2Te_3.

HL 97.7 Fri 11:30 H15

Bi2Se3-based heterostructures including magnetic layers: the case of n-QLs Bi2Se3 ontop of Mn-doped Bi2Se3 — •J. Honolka[1], M. Valiska[2], J. Warmuth[3], M. Michiardi[4], M. Vondracek[1], A. S. Ngankeu[4], V. Holy[2], M. Bianchi[4], G.

Springholz[5], V. Sechovsky[2], P. Hofmann[4], and J. Wiebe[3] — [1]Institute of Physics, ASCR, Prague, CZ — [2]Department of Condensed Matter, Charles University, Prague, CZ — [3]INF, University of Hamburg, Hamburg, DE — [4]Department of Physics and Astronomy, iNANO, University of Aarhus, Aarhus, DK — [5]Institute of Semiconductor Physics and Solid Solid State Physics, Johannes-Kepler University, Linz, AT

Interfaces between ferromagnetic and non-magnetic Bi2Se3 phases are studied as a material platform to investigate the influence of spin degrees of freedom on 3D topological insulator (TI) properties.

An inverted geometry of n quintuple layers (QLs) Bi2Se3 ontop of Mn-doped Bi2Se3 is achieved by molecular beam epitaxy for n=0 to n=24 QLs and allows to unhamperedly monitor the development of electronic and topological properties by surface sensitive key techniques like angular resolved photoemission spectroscopy. A gap at the Dirac point is observed at small n, which is gradually filled with increasing n. The Dirac point is fully reestablished at about n = 9 QLs. Band bending effects due to the proximity of the interface with the ferromagnetic layers are discussed.

HL 97.8 Fri 11:45 H15

Observation of gapped surface states in the topological regime of the quantum-phase transition in Bi-doped Pb-Sn-Se (111) epitaxial films — •Partha Sarathi Mandal[1], Gunther Springholz[2], Valentyn Volobuev[2], Günther Bauer[2], Evangelos Golias[1], Andrei Varykhalov[1], Jaime Sa'nchez-Barriga[1], and Oliver Rader[1] — [1]Helmholtz-Zentrum Berlin für Materialien und Energie, Berlin, Germany — [2]Institut für Halbleiter und Festkörperphysik, Johannes Kepler Universität, Linz, Austria

Topological crystalline insulators are believed to show a straight forward and versatile connection between mirror symmetries and gap opening at the surface Dirac points. Here we systematically studied the trivial-to-topological insulator phase transition [1] of the $Pb_{1-x}Sn_xSe(111)$ surface grown by molecular beam epitaxy and using angle-resolved photoemission spectorscopy (ARPES) under variation of Sn concentration (10 to 28%) and temperature. Differently from the case of the (001) surface [2], we observe two types of Dirac cones centered at $\overline{\Gamma}$ and $\overline{\mathrm{M}}$ in the surface Brillouin zone. By comparing the band structure of samples with fixed Sn concentration and different Bi doping, we demonstrate the existence of gapped surface states within the topological regime of the quantum-phase transition at low temperatures [1].

[1] Y. Ando and L. Fu Annual Review of Condensed Matter Physics Vol. 6: 361-381 (2015). [2] Y. Tanaka, T. Shoman, K. Nakayama, S. Souma, T. Sato, T. Takahashi, M. Novak, Kouji Segawa, and Yoichi Ando PHYSICAL REVIEW B 88, 235126 (2013).