Institut für Physik

Montanuniversität Leoben

A-8700 LEOBEN, Franz Josef Straße 18, Austria
Tel: +43 3842 402-4601, Fax:+43 3842 402-4602
e-mail: physics@unileoben.ac.at

S E M I N A R
aus
Halbleiterphysik und Nanotechnologie

<u>Di, 26.2.2019, 12:00 Uhr</u>, Hörsaal für Physik

Topological Surface States in 2D and 3D HgTe

Prof. Dr. Hartmut Buhmann

Experimental Physics 3, University of Würzburg, Germany

Mercury-Telluride (HgTe) is a semimetal with an inverted band structure. Strain and quantum confinement can be used to lift the degeneracy and turn the material into a topological insulator (TI). TIs are characterized by an insulating bulk and conducting surfaces. The conducting surface states exhibit a characteristic spin-momentum locked Dirac band dispersion and therefore offer a lot of new and interesting properties, especially with respect to future device applications.

(HgTe) is introduced as a proto-type for the investigation of topological transport properties in two-dimensional (2D) as well as in three-dimensional (3D) systems. The realization of a 2D TI structure in HgTe quantum wells has already demonstrated the potential for spin injection and detection purposes in spintronic applications without any magnetic materials or applied magnetic fields [1,2,3]. However, transport experiments on 3D TI surface states are rare, even though numerous TI materials have been identified and fabricated worldwide. Again HgTe appears to be the appropriate material for these kind of investigations [4,5].

Here, I will introduce the concept of topological insulators and the related transport properties. I will present the state of the art for 2D and 3D HgTe TI structures, and will introduce the concept of band gap engineering which leads to the formation of Dirac and Kane semimetal states [6,7]. I will briefly introduce the fabrication of core-shell TI nanowires [8] and the observation of topological superconductivity [9,10,11].

References

[1] M. König et al., Science 318, 766 (2007).
[2] A. Roth et al., Science 325, 294 (2009).
[3] C. Brüne et al., Nature Physics 8, 485 (2012).
[4] C. Brüne et al., Phys. Rev. Lett. 106, 126803 (2011).
[5] C. Brüne et al., Phys. Rev. X 4, 041045 (2014).
[6] P. Leubner *et al.*, Phys. Rev. Lett. **117**, 126803 (2016).
[7] D.M. Mahler *et al.*, submitted to PRX (2018).
[8] M. Kessel *et al.*, Phys. Rev. Mat. **1**, 023401 (2017).
[9] L. Maier *et al.*, Phys. Rev. Lett. 109, 186806 (2012).
[10] J. Wiedenmann *et al.*, Nature Communications 7, 10303 (2016).
[11] J. Wiedenmann *et al.*, Phys. Rev. B **96**, 165302 (2017).