How Robust are Topological States?

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Topological insulators (TIs) have recently attracted considerable interest because they host linearly dispersing surface states that are strongly spin-orbit–coupled such that spin and electron momentum are tightly locked, thereby resulting in charge currents which are intrinsically tied to the spin. This property makes TIs a promising candidate for spintronics applications. In this talk I will describe how TIs respond to magnetic dopants that are deposited onto the surface [1,2] or into the bulk [3]. In particular, I will discuss various electronic scattering channels, which can be mapped by the so-called quasiparticle interference (QPI) method. In combination with local tunneling spectroscopy it allows for an extremely precise understanding of how topological states respond to magnetic impurities at the atomic scale. The combination of real and reciprocal space techniques elucidates a delicate balance between two opposite trends, that is, gap opening and the emergence of a Dirac node impurity bands, both induced by the magnetic dopants [3]. Finally, I will report on the discovery of a new type of one-dimensional (1D) electronic states which exist at step edges of the topological crystalline insulator (TCI) $Pb_{1-x}Sn_xSe$ [4]. They form conductive channels which are only 10 nanometers wide and exhibit a surprising robustness against external perturbations.

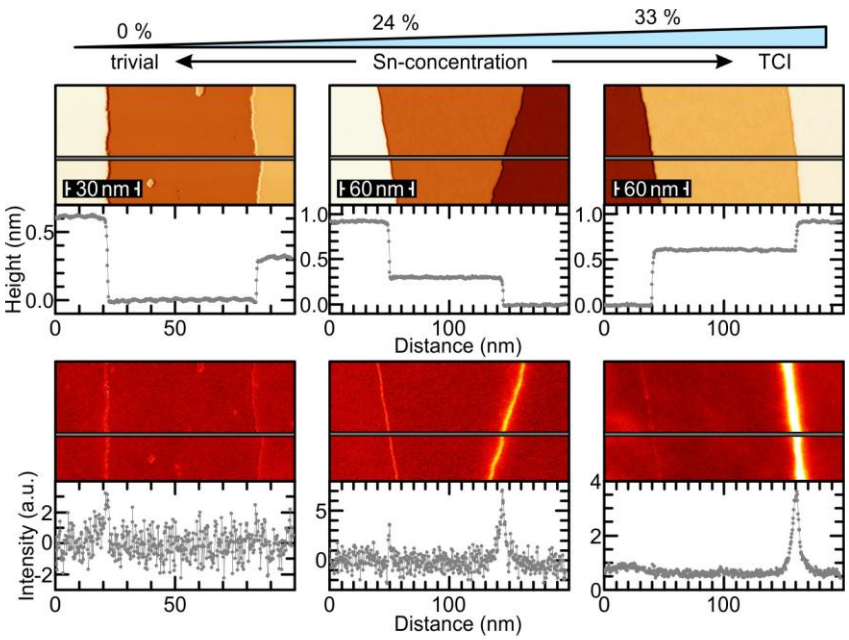

Fig. 1: Sn concentration-dependent electronic properties of (Pb,Sn)Se. Topography (left), d*I*/d*U* maps (right), and their corresponding profiles taken along the indicated line (bottom of each panel), measured on $Pb_{1-x}Sn_xSe$ crystals with different Sn content, i.e. $x = 0$ (left), $x = 0.24$ (middle), and $x = 0.33$ (right column), thereby spanning the entire range from trivial to topological surfaces.

References:

[1] P. Sessi *et al.*, Nature Comm. **5**, 5349 (2014)
[2] T. Bathon *et al.*, Nano Lett. **15**, 2442 (2015)
[3] P. Sessi *et al.*, Nature Comm. **7**, 12027 (2016)
[4] P. Sessi *et al.*, Science 354, 1269 (2016)