Band gaps in the surface state of topological insulators

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Three dimensional topological insulators (TI's) are characterised by a massless Dirac surface state, which is protected by the time reversal symmetry. The time reversal symmetry can be broken by introducing a magnetic order, which leads to the opening of a band gap in the surface state of topological insulators. This property is highly desired for many applications, e.g. for a realisation of quantum anomalous Hall effect. A magnetic order in topological insulators can be introduced by doping with magnetic impurities such as transition metal or lanthanide magnetic ions. Several experiments demonstrated recently this effect in Bi_2Se_3, Bi_2Te_3, and other topological insulators using mainly V, Cr and Mn magnetic dopants. However, it is known that impurities, defects or other surface/bulk imperfections may also lead to the opening of band gap in the TI surface state despite the topological protection by the time reversal symmetry. Unfortunately, in many cases the origin of the band gap can not be determined experimentally. In my talk I analyse recent experimental results in this research field using a first-principles approach based on the multiple scattering theory and a coherent potential approximation. Finally, I present a simple method, which makes it possible to reveal the origin of the band gap in these systems.

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