Abstract

Topological Insulators (TIs) have become one of the wonder materials of condensed matter physics due to their novel properties. They possess an electrically insulating bulk in coexistence with metallic boundary states, presenting a Dirac-like dispersion in which carrier’s spins are helically polarized. The introduction of magnetic order to such states can give rise to novel magneto-electronic phenomena such as the Quantum Anomalous Hall Effect, which holds great potential for spintronics, quantum computing and metrology. Nevertheless, the emergence of such phenomena critically relies on the capability to control the delicate magnetic and electronic interplays occurring between the TIs and the magnetic agent.

In this thesis, we have focused on the study of heterostructures formed by magnetic Metal-Organic layers in contact with 3D Topological Insulators, as an approach to engineer the crucial interactions occurring at the interface between magnetic and topological materials. On one hand, the synthesis of high-quality TI crystals by MBE growth technique has been assessed. We have shown how the Fermi level can be gradually tuned across the bulk band gap by: (i) increasing the crystalline quality of the TI and (ii) altering the stoichiometry via the addition of extrinsic elements. Such control over the doping level make these TIs ideal for the integration in heterostructures, since they tend become n-doped when put in contact with other materials. On the other hand, we have seen that the use of a magnetic ion caged in organic ligands enables a great control over its spin and electronic states, which gives rise to interfaces where magnetic and topological properties are preserved in direct contact. The reported heterostructures define a benchmark scenario where the magnetic and the topological properties can be engineered independently, thus encouraging the further study of such systems to induce magnetic order in the TIs.