PHYSIKKOLLOQUIUM
Fachbereich für Physik

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über

Towards active molecular spintronics

Abstract:

Functionalizing moelcular interfaces by tailored organic bonds

Recent developments in molecular spintronics indicate that the deposition of aromatic organic molecules on the strongly reactive surfaces of ferromagnetic metals leads to a change in the local magnetic properties of the atoms hybridized with the molecule, such as exchange interaction, magnetic moments, and magneto-crystalline anisotropy [1].

In this talk I will show that the extreme multi-functionality of organic molecules can be used to functionalize the spin properties of the more general class of surfaces with a spin-texture induced by strong spin-orbit coupling. In particular, I will present our results on the following two-dimensional electronic systems: the surface states of the topological insulator (TI) Bi2Se3 [2], and the Rashba-split surface states of a Pb-Ag surface alloy [3].

In the case of the TI surface states, we have used theoretical calculations to guide the choice and chemical synthesis of appropriate molecules that customize the spin-texture of Bi2Se3. The theoretical predictions are then verified in angular-resolved photoemission (ARPES) experiments. We show that by tuning the strength of molecule-TI interaction, the surface of the TI can be passivated, the Dirac point can energetically be shifted at will, and Rashba-split quantum-well interface states can be created [2].

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In the case of the Pb-Ag alloy, we have studied the influence of specific chemical bonds - as formed by the organic molecules CuPc and PTCDA- on the electronic structure of the surface alloy using momentum microscopy [4]. We have found that delocalized van der Waals or weak chemical pi-type bonds are not strong enough to alter the alloy. On the other hand, localized sigma-type bonds lead to a vertical displacement of the Pb surface atoms, which on turn leads to pronounced changes in the alloy's surface band structure, including its spin texture [3].

Our results provide an exciting platform for tailoring spin-textured surface states using the controlled hybridization of organic molecules.

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