INTERNSHIP PROPOSAL

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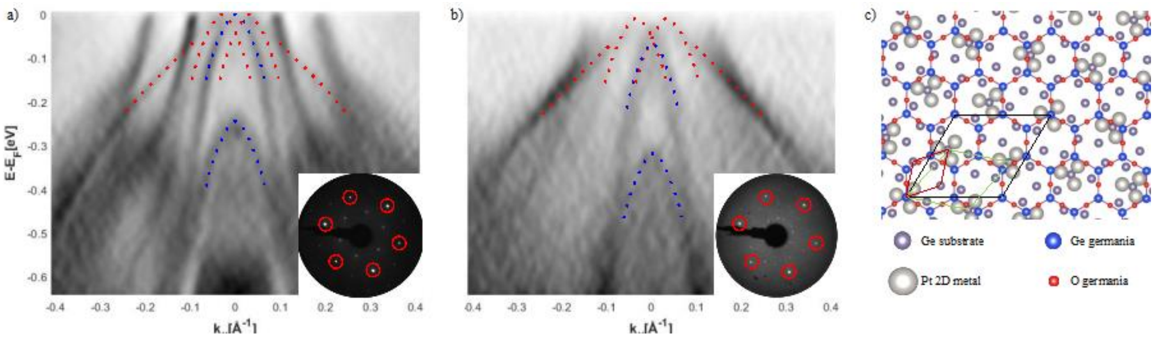
Thesis possibility after internship: YES

Toward 2D electron gases with strong spin-orbit coupling in crystalline metal-semiconductor heterostructures

The possibility to interconvert electronic spin and charge has opened new research frontiers pushing the rise of spintronics. The ultimate goal consists in the use of the spin degree of freedom for information storage and computing devices. The key challenge resides in the generation and detection of a spin-current. The Edelstein effect (EE) is currently the most promising charge-spin conversion principle where spin accumulation is achieved exploiting the spin-momentum locking linked to the charge current flow at a material's interface or surface where electronic states are spin-splitted by Rashba effect. To maximize the EE figure of merit the Rashba-split energy band at the Fermi level must be the largest possible, and the electron scattering rate the lowest possible. Prominent candidates are heavy metallic single atomic layers that can be deposited at the surface of semiconductor wafers. These interfaces have been investigated using surfaces physics techniques, i.e. in ultra-high vacuum (UHV) environments. They were found to produce giant Rashba splitting and very low effective mass states, which is promising in terms of electronic mobility. The main goal of this project is to make use of the two-dimensional electron gas (2DEG) in single heavy atomic layers on semiconductor for charge-spin conversion. When exposed to air, the electron gas is destroyed by airborne surface pollutions. We propose overcome this problem protecting the system by a dielectric capping layer prepared in UHV conditions. Once this will be done, the energy of the Rashba-split states will become tunable via an electric field applied with a top-gate through the dielectric capping layer. The internship will be focused on the growth, the structural and electronic characterization of a germanium oxide capping layer on Pt single atomic layer on germanium substrate (see figure). The study will be performed by angle resolved photoemission electron spectroscopy (ARPES) and diffraction techniques. Finally, we will quantitatively evaluate the charge-spin conversion efficiency by transport experiments on patterned samples.



ARPES measurements demonstrating the Rashba effect on Pt/Ge(111) a) and its preservation after the growth of the capping layer. C) schematic representation of the sample.