PhD on topological insulators/magnetic systems for spin-charge conversion

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The PhD work is on spin to charge current conversion study from a BiSb topological insulator. A large effort will be dedicated to MBE growth aiming at the control of structural and electronic interfacial properties of new TI/Ferromagnetic heterostructures. Three laboratories will be mainly involved in the PhD work addressing this topic. It will involve C2N which has recently started the study of BiSb MBE growth, the researchers from the CASSIOPEE beamline at Synchrotron SOLEIL (Angle-Resolved PhotoEmission Spectroscopy-ARPES) and Spin Angle-Resolved PhotoEmission Spectroscopy -SARPES)) and UMPhy for the magneto-transport and spintronic properties. The PhD work will first focus on the control of surface states in BiSb [HSIE2008,BEIN2015] and InSb [VERG2019] and then on the growth of a ferromagnetic diluted magnetic semiconductor with perpendicular magnetization that will be GaMnAsP (Tc = 200 K). The main advantage compared to existing other TI/ferromagnetic systems is that all these materials can be elaborated in the same chamber and have been already successfully grown separately by C2N [LEMA2208]. The main challenge will be then the ability to grow BiSb or InSb on top of thin layers of GaMnAsP. Moreover, it will be also possible to explore MnBi and MnSb compounds with Curie temperatures above room temperature.

The structural properties will be investigated by X-ray reflectivity (UMPhy, C2N) and Transmission Electron Microscopy (C2N). The electronic properties will be probed by ARPES and SARPES (SOLEIL) and magnetotransport (UMPhy). The magnetic properties of GaMnAsP will be probed by low temperature MFM (UMPhy) and magnetization reversal using the Edelstein effect from the TI will be probed by measuring the Anomalous Hall Effect in a Hall bar geometry (UMPhy). For ferromagnetic materials with Curie temperatures above room temperature like MnSb and MnBi, the magnetization dynamics with pulse currents will be probed by Kerr microscopy adding a complementary tool to magnetotransport.

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