Post-doctorate: Electronic and structural characterization of $Bi_{1-x}Sb_x$ thin layers integrated by molecular beam epitaxy on GaAs substrate

Supervisors: Corentin Durand (LAAS – MPN)
Roland Coratger (CEMES - SINanO)

General information:

Workplace : CEMES-CNRS et LAAS-CNRS (Toulouse, France)
Type of Contract : FTC Scientist
Contract Period : 18 months
Expected date of employment: October 1st 2022
Remuneration: 2663.79 € gross per month

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Keywords: electrical characterization, topological insulator, electronic transport, scanning tunneling microscopy.

https://emploi.cnrs.fr/Offres/CDD/UPR8001-CORDUR-001/Default.aspx

Context:

Hybrid materials are those which combine materials of dissimilar classes and can unlock new fields in condensed matter. For instance, combining Topological Insulators (TI) and Magnetic Materials could bring new quantum phenomena into everyday devices. Indeed, the development of new universal memories based on Spin Orbit Torques is revolutionizing the Random Access Memory (RAM) industry since it unlocks the development of faster, greener and scalable MRAMs [1]. Here we propose to study these key interfaces from a fundamental point of view. Among bulk TI, $Bi_{1-x}Sb_x$ was the first one reported experimentally in 2008 [2]. We recently demonstrated the 2D integration of in this TI on GaAs [3] and proved its outstanding electrical properties. With the HyTop project, we propose to study interactions between Cobalt, a magnetic material, and BiSb from the structural to the transport properties. The postdoctoral fellow will work in collaboration with different researchers from LAAS and CEMES.

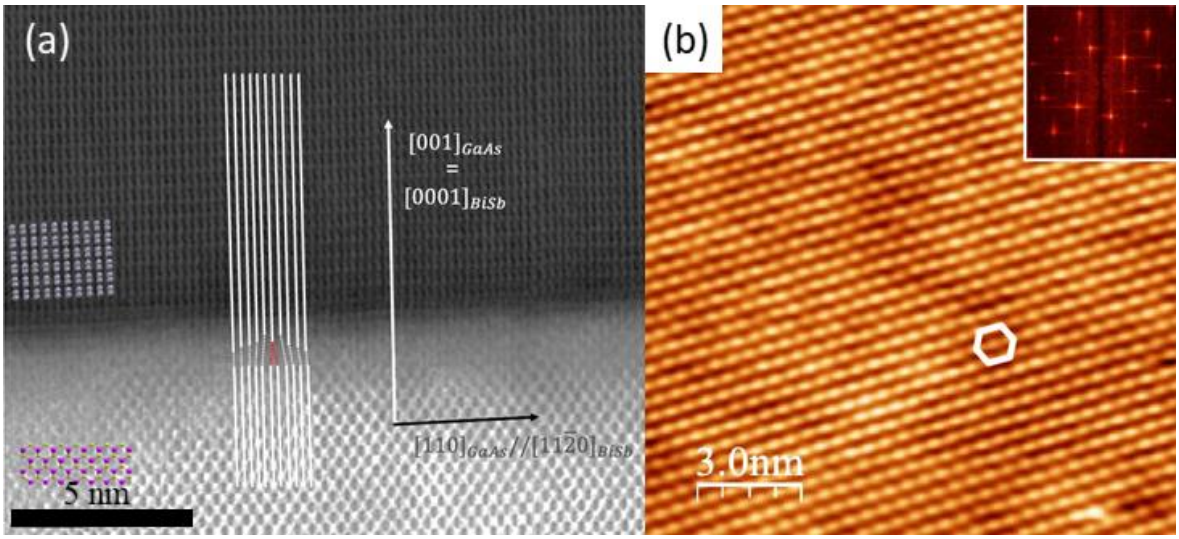

Figure 1: a) HR-TEM image of the interface between the BiSb layer and the GaAs(001) substrate. b) STM image (V = 0.8V ; T =77K) of the BiSb(111) facet showing atomic resolution. Insert : Fourier transform.

Missions:

The first part of the postdoctoral fellow mission is related to the optimization of $Bi_{1-x}Sb_x$ growth. He/she will be in charge of the structural and electrical characterization of the MBE as-grown $Bi_{1-x}Sb_x$ layers and participate to a virtuous cycle between growth and characterization. On selected samples, he/she will perform electronic transport and Scanning Tunneling Microscopy (STM) measurements in order to investigate the properties of bare $Bi_{1-x}Sb_x$ and, in a second steps, the interactions at its surface with cobalt (deposited with extremely low coverage, from few atoms to several nanometers).

Activities:

MBE growth of the TI $Bi_{1-x}Sb_x$ will be performed at LAAS by Dr. S. Plissard. One of the main tasks of the postdoctoral fellow will be to take care of the structural characterization of the samples right after the growth with the characterization facilities available at LAAS. He/she will provide a direct feedback about the obtained structural quality. With Dr. C. Durand, he/she will also conduct electrical measurements on patterned samples (which includes devices fabrication by lithography) at LAAS to investigate their transport properties at low temperature and under low magnetic field. High magnetic field are also considered. For advanced structural and electronic characterization, the postdoctoral fellow will participate to STM measurements performed at CEMES, supervised by Pr. R. Coratger. For all the characterization steps, he/will be involved in data analysis, reports writings. He/she will attend to meetings and perform oral presentation about his/her results.

Skills:

- PhD. In condensed-matter physics
- Microfabrication
- Electrical characterization
- Experience in structural characterization of materials is a plus
- Skills in Ultra High Vacuum and Scanning Probe Microscopy will be highly considered.
- Good skills in English (writings, speaking, presenting)

[1] N.H.D. Khang *et al.*, Nature Mater. **17**, 808 (2018)
[2] D. Hsieh *et al.* Nature **452**, 970 (2008)
[3] D. Sadek *et al.* ACS Appl. Mater. Interfaces **13**, 36492 (2021)