INTERNSHIP PROPOSAL

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Thesis possibility after internship: YES

Tuning the electronic and magnetic properties of 2D antimonene via doping with magnetic impurities

Two-dimensional (2D) materials form a large family of systems that show unique properties distinct from their bulk counterparts. The range of novel properties is further extended in heterostructures combining different 2D materials, revealing a great potential for applications in electronics, optoelectronics, spintronics, quantum technology and more. Among known 2D materials, antimonene, a 2D honeycomb lattice composed of Sb atoms, has sparked a strong interest in the scientific community as it revealed a direct band gap, high mobility of charge carriers and resistance to ambient conditions [1]. Antimonene has been already successfully grown on several substrates, including topological insulators [2]. Recent theoretical predictions show the possibility of inducing ferromagnetic ordering in antimonene via doping with magnetic impurities, which makes it extremely appealing for designing novel quantum phases and applications in spintronics [3]. In this project, we propose to induce room temperature ferromagnetism in 2D antimonene grown on a variety of substrates, including topological insulators and superconductors, by substitutional doping or surface adsorption of 3d and 4f elements. We will also investigate the possibility of using antimonene as a suitable support for extending and controlling the spin lifetime of isolated adatoms. The use of topological insulators or superconductors as substrates will allow to investigate the interplay between the electronic properties of the substrate and the magnetic properties in antimonene. The project, conducted in collaboration with the EPFL, Switzerland, will capitalize on the strong and broad expertise of the partners, including growth of 2D materials, investigation of their electronic and magnetic properties, using ARPES and XMCD measurements, respectively, and performing first-principles calculations on low-dimensional systems hosting magnetic and topological phases.

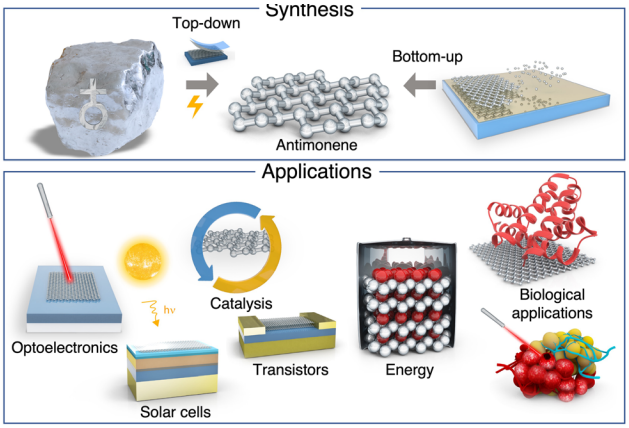

Figure: Summary of Antimonene synthesis and applications.[1]

[1] J. A. Carrasco *et al*. *Chem*. *Soc*. *Rev*., 2023, **52**, 1288
[2] C. Hoogan *et al*. *ACS Nano,* 2019, **13**, 10481
[3] X. Han *et al*. *Electron*. *Mater*. 2024, **53**, 1816