Inversion symmetry-breaking tellurides for spin-orbitronics

Laboratory: Centre Interdisciplinaire de Nanoscience de Marseille, CINaM (Campus Luminy)

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Subject:

Spintronics aims at changing the standard information technology (IT) concepts of data storage, transfer and processing by harvesting the intrinsic angular momentum of carriers instead of solely exploiting their electric charge. The most recent developments of spintronics, termed spin-orbitronics, utilize the functionalities of the spin-orbit coupling (SOC) to manipulate spins. New generation of non-volatile spin-orbitronic devices rely on the low-energy cost of a voltage-induced ferroelectric switching, as compared to a current-induced magnetization switching [1–3]. In this context, the emergent ferroelectric Rashba semiconductors (FERSC) with GeTe as founding material stand out as versatile platforms for the realization of low-power all-electric controlled spintronic devices [4,5]. This new class of materials requires a non-centrosymmetric crystal structure that supports a ferroelectric polarization while a strong Rashba effect is favored by chemical elements with high atomic number.

At CINaM, the Surface Structure and Dynamics (SSD) team offers a funding for a PhD project on the investigation of different Te-based epitaxial systems with inversion symmetry breaking and ferroelectric properties to demonstrate their high applicative potential for spin-orbitronic technologies. The SSD team has developed a solid knowhow on the elaboration of ferroelectric GeTe thin films [6–8] and on 2D WTe_2 [9]. The project goals are *(i)* to explore uncovered epitaxial Te-based systems and *(ii)* to demonstrate an *in situ* actuation of electronic properties using photoemission techniques (ARPES, SR-ARPES) in synchrotron facilities. This project benefits from a highly collaborative environment with theoreticians at CINaM, condensed matter physicists at Institut Jean Lamour (Nancy, France) and experts in spin-dependent transport (SPINTEC, France).

Candidate profile: The candidate must hold, by July 2024, a Master degree in physics, nanoscience, or any equivalent diploma. He/she should be strongly motivated in materials elaboration and should have a solid background in condensed matter physics/nanophysics. Interest in *ab initio* calculations would be appreciated.

References:

[1] S. Manipatruni *et al.*, Nature 565 (2019) 35.
[2] P. Noël *et al.*, Nature 580 (2020) 483.
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[4] C. Rinaldi *et al.*, Nano Lett. 18 (2018) 2751.
[5] J. Krempaský *et al.*, Phys. Rev. X **8** (2018) 021067.
[6] B. Croes *et al.*, Phys. Rev. Mater. **5** (2021) 124415.
[7] B. Croes *et al.*, Phys. Rev. Mater. **7** (2023) 14409.
[8] B. Croes *et al.*, Phys. Rev. B **109** (2024) 024103.
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