

INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: Matériaux et Phénomènes Quantiques (MPQ)

CNRS identification code: UMR 7162

Internship director's surname: Philippe Lafarge

e-mail: philippe.lafarge@u-paris.fr

Phone number: 01 57 27 62 41

Web page: <https://mpq.u-paris.fr/telem/>

Internship location: MPQ lab, 75013 Paris

Thesis possibility after internship: YES

Funding: YES/NO

If YES, which type of funding:

Molecular electronics with 2D materials

2D materials like graphene, hexagonal Boron Nitride (hBN) and transition metal dichalcogenides (MoS₂, WSe₂) have unique electronic and optical properties together with flexibility, high-speed operation and standard CMOS fabrication processes compatibility. These make them appealing to embed them as active layer in molecular electronic devices [1,2]. The aim of the internship is to use 2D semiconductors to overcome the issue of gating in vertically stacked molecular junctions.

The typical structure will be Au/hBN/WSe₂/molecules/Au with a lateral metal contact on the WSe₂ layer to form the junction in such a way that electronic transport will be governed by three interfaces: metal/ WSe₂, WSe₂/molecules and molecules/Au. Tuning both the carrier density in the 2D semiconductor and the band alignment at interfaces can be achieved by means of the bottom Au layer. The realisation of the junctions will take advantage of recent results obtained by the group on WSe₂ based molecular junctions and on metallic contacts on few-layers 2D materials.

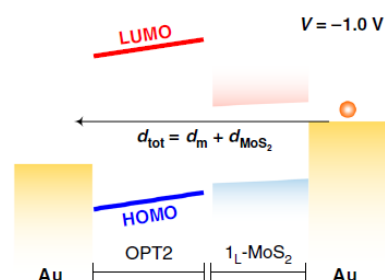


Figure : Band structure alignment in Au/molecules/MoS₂/Au molecular junction showing the charge transport mechanism across the structure. Taken from [2]

[1] C. Jin and G. C. Solomon, J. Phys. Chem C. 122, 14233 (2018)

[2] J. Shin et al., Nature Comm. 11, 1412 (2020)

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics: YES Soft Matter and Biological Physics: NO
Quantum Physics: NO Theoretical Physics: NO