Open postdoctoral position at
Laboratoire Matériaux et Phénomènes Quantiques, Paris, France

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Controlling the properties of 2D materials by defect engineering and atomic scale characterization by scanning tunneling microscopy

The isolation of graphene in 2004 led to the rise of the field of layered two-dimensional (2D) materials that continues to foster tremendous worldwide research activities. In all 2D materials, imperfections are unavoidable. Such imperfections, e.g., vacancies or substitutional/intercalated atoms etc., when combined with the low-dimensionality and enhanced surface/volume ratio, can in principle be engineered to give desirable properties such as reactive catalytic sites, magnetism, or quantum light emission. In this context, defect engineering has recently emerged as a promising strategy to tune the properties of 2D materials.

In this project, we will use scanning tunneling microscopy and spectroscopy operating under ultra-high vacuum and at low temperature (4K) to study the structure and electronic properties of generated defects in selected 2D materials at the atomic scale. The targeted 2D materials are graphene, black phosphorus, and transition metal dichalcogenides (TMDs) (Figure 1). Substitutional atoms (such as nitrogen in graphene), intercalated atoms (metals or alkali) will be used to tune the properties of these materials in order to reach new functionalities. The impact of defects on the density of states and ordered states such as charge density waves will be investigated. The interaction of defect sites with adsorbed molecules will be probed as well to reveal the impact of the defects on the chemical activity of 2D materials (Figure 2). In addition, we have recently developed a technique to realize p-n junctions in chemically doped graphene which opens new ways to study sharp junctions at the atomic scale.

This proposal is part of the ANR project DEFINE2D.

The candidate must have a completed PhD degree in physics a strong background in solid state physics and a good knowledge and practice in scanning tunneling microscopy.

The starting of the position will be during the year 2022 for a duration of one year extendable to two years.

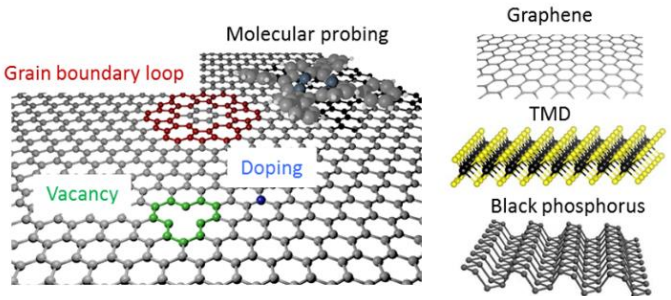

Figure 1: Defect engineering in 2D materials – defects and molecular interaction in graphene, transition metal dichalcogenides and black phosphorus

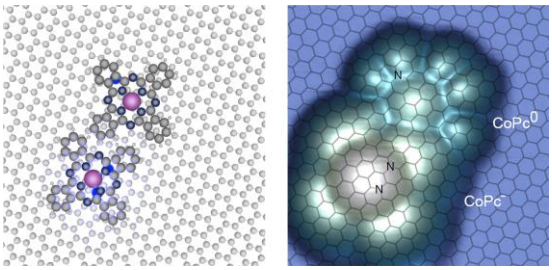

Figure 2: Scheme (left) and STM image (right), with a lateral size of 4 nm, of two CoPc molecules on nitrogen doped graphene. The molecule located above a nitrogen pair is charged while the molecule above a single nitrogen is neutral.
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