Black Phosphorus as a template to drive molecular assembly with weak electronic coupling

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The emergence of two-dimensional (2D) materials has triggered the search for new surface functionalities. In the wide family of 2D materials, black phosphorus (BP) takes a particular place due to it is monoelemental layered nature with a non-planar structure. The combination of 2D materials with organic molecules is expected to provide new opportunities for realizing hybrid structures with novel physical properties. Several studies have been performed for molecules on graphene, especially using scanning tunneling microscopy (STM), however experiments of molecules on BP are still scarce. Here, we have studied the interaction of BP with iron porphyrin molecules using low temperature STM combined with ab initio calculations [1]. We show that the molecules self-assemble on the surface and that the molecule-substrate interaction is the dominant factor that drives the self-assembly. The electronic interaction has been probed by scanning tunneling spectroscopy and compared with the spectroscopy of the molecules on other substrates such as graphene and Au(111) [2]. A weak electronic coupling can be evidenced and is confirmed by ab initio calculations. As a consequence, black phosphorus appears to combine two properties which usually exclude each other, a strong interaction with molecules driving molecular assembly and a weak interaction for the electronic coupling.

References

[1] M. Bouatou et al., submitted
[2] M. Bouatou et al., J. Phys. Chem. Lett. 11, (2020) 9329

Figures

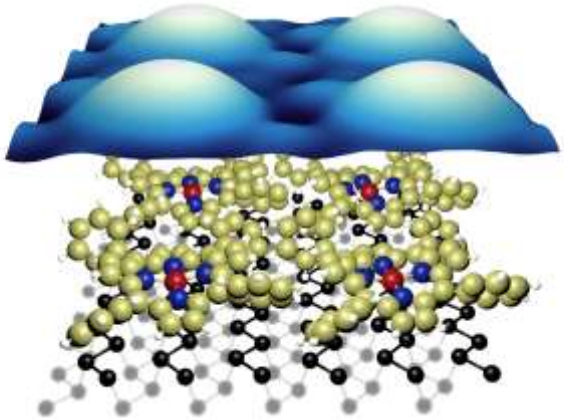

Figure 1: STM image and model of FeTPP molecules adsorbed on black phosphorus