Engineering topological states in arrays of magnetic molecules through interaction with a 2D superconductor

D. Longo[1], C. Brun[1], H.Cruguel[1], S. Royer[1], A. Palacio-Morales[1], F. Debontridder[1], P. David[1], N.Witkowski[1], T.Cren[1]

[1] *Institut des NanoSciences de Paris, Sorbonne Université & CNRS, 4 place Jussieu - 75005 Paris, France*

danilo.longo@insp.upmc.fr

Recent investigation of ultrathin metal films with atomically well-defined thickness and high crystallinity has shown the existence of 2D superconductivity down to a single atomic layer as shown in Pb/Si(111) monolayers [1]. Pb/Si(111) has different surface structures depending on conditions of preparation such as the Pb coverage and the annealing temperature. Since this system consists of heavy atoms, there also exists a strong Rashba spin-orbit coupling modifying the electronic properties. Combining the Pb/Si(111) system with local magnetism makes it an ideal platform in which topological superconductivity signatures can be searched [2]. Magnetic phthalocyanines (Pcs) are very promising metallo-organic molecules which can be used to introduce two-dimensional magnetic structures [3]. Such molecules are expected to induce new exotic electronic states on low-dimensional superconductor systems such as Pb/Si(111).

I will present how magnetic phthalocyanines of MnPc adsorb on the different crystalline phases of lead monolayer presenting either the √7x√3-Pb reconstruction or the so-called SIC-Pb phase. In particular, I will show that depositing few molecules of MnPc induces a structural transition from the √7x√3-Pb/Si(111) to the SIC-Pb/Si(111) phase (Fig.1). Through complementary measurements, I will discuss how by changing the initial structure in the Pb monolayer, e.g. by changing the surface reconstruction, can dramatically change both the diffusion and the self-assembly properties of MnPcs and conversely the system response to molecular adsorption.

Then, I will present how MnPcs adsorption affect the growth of three Pb layers when deposited on the Si(111). In particular, I will highlight the surprising role of MnPcs in stabilising the three layers up to higher temperatures. I will also show the great variety of molecular self-assemblies that is found on this surface due to the coexistence of different Moiré patterns on the surface (Fig.2).

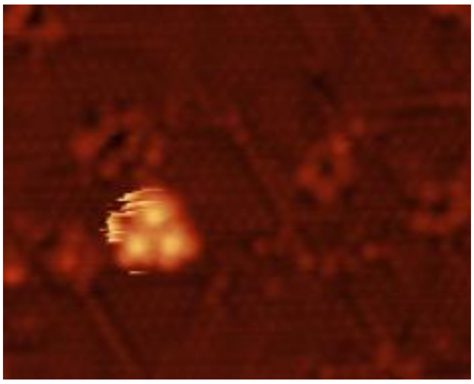

Fig.1: SIC reconstructed surface after MnPc adsorption (7.8x6.2)nm^2

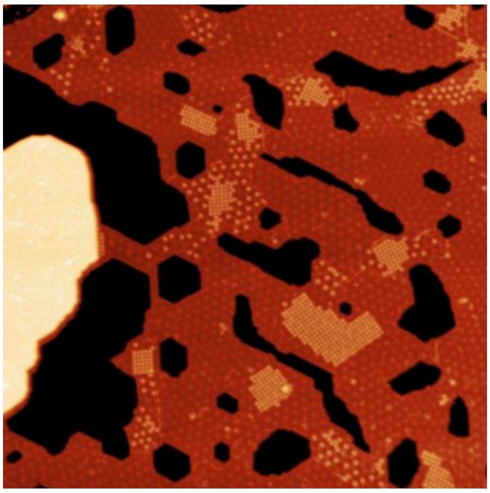

Fig.2: Different type of self-assembled MnPc arrays on 3ML of Pb (207,5x207,5)nm^2

References:
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