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 (Rashba SOC) modifying the electronic properties. Pb/Si(111) grows by Stranski-Krastanov mode. Firstly, a wetting layer made up of a single atomic layer with a striped incommensurate reconstruction (SIC) is formed, then, Pb islands with specific thicknesses (3, 5, 7, … monolayers) start to grow up on top of it. This bilayer growth arises from the presence of stabilising quantum size effects [4]. In order to maintain a relatively strong Rashba SOC we focused on the first stable thicknesses, i.e. 3 and 5 monolayers. On the top of the islands we observed different Moiré patterns, each with a specific corrugation and periodicity (Fig.1). Moiré patterns are dominated by substrate-mediated structural effects, e.g. lattice mismatch and misorientation between Si substrate and Pb overlayer, and/or atomic relaxation at the Pb/Si interface [5]. The coexistence of islands with different thicknesses and Moiré patterns highlights the role played by the different thicknesses and structures in self-assembly of MnPc molecules. Depending on the thickness and/or the Moiré on which molecules adsorb different molecular assemblies can be observed.

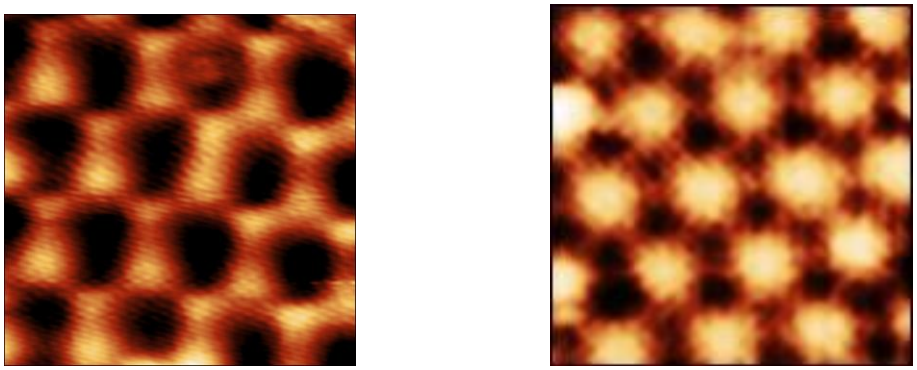

Fig.1: Two different Hexagonal corrugation patterns (Moiré) on top of 3ML Pb islands. Image size: *14* × *14* nm^2

References:
[1] T. Zhang, P. Cheng, Nature Physics **6**, 104 (2010).
[2] C. Brun, T. Cren, Supercond. Sci. Technol. **30,** 013003 (2017).
[3] K. J. Franke, G. Schulze, Science **332**, 940 (2011).
[4] Z. Zhang, Q. Niu, Phys. Rev.Lett. **80**, 5381 (1998).
[5] Tzu-Liang Chan, Retrospective These and Dissertations, Iowa State University (2005).