

## Molecular Magnets: From the single molecule to the 3D self-assembly

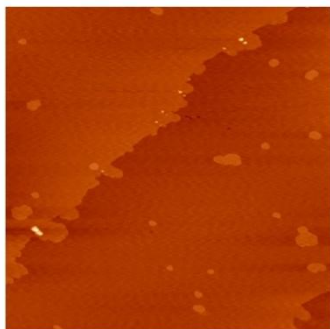
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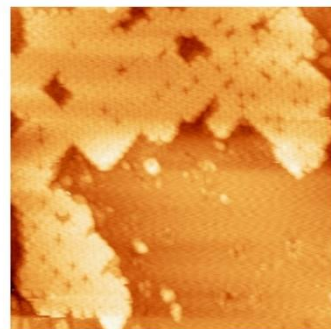
The presence of magnetic disorder in s-wave superconductors is able to reduce the superconducting BCS gap and may ultimately destroy the coherence of the superconducting state. A single magnetic impurity, presenting a large spin number, behaves classically and is able to create a localized state within the BCS gap, known as Shiba state. A finite concentration of classical magnetic impurities can form an impurity band from the overlapping Shiba states, within the superconducting gap. The spatial decay of these bound states critically depends on the dimensionality of the system, i.e. it is increased by reducing the dimensionality [1]. Under some specific conditions, magnetic interaction between several Shiba states in a either one-dimensional or two-dimensional array of magnetic impurities on the surface of a superconductor may realize new topological phases [2].

One of the most remarkable examples of 2D superconductors is Pb/Si(111), since superconductivity can arise in a single atomic plane of Pb [3,4]. In this poster, I will summarize the results related to the surface characterization of this system and its complex structural phases by means of LEED and STM measurements at room temperature.

Magnetic phthalocyanines (Pc) are very promising metal-organic molecules which can be used as magnetic impurities when evaporated on a superconducting substrate [5]. Because of the chemical flexibility of Pcs, their spin angular momentum can be tuned by simply replacing the magnetic central atom, e.g. MnPc have  $s=5/2$  whereas for the TbPc2  $S=3$ . Moreover, Pcs are known to form 2D self-assemblies on various metallic surfaces which make possible to tailor two-dimensional ordered magnetic structures. Results about 2D self-assembly of phthalocyanines on Pb/Si(111) in the sub-monolayer regime will be also shown.



Pb/Si(111), 500 × 500 nm<sup>2</sup>, V = +3.5V, RT



LuPc<sub>2</sub>/Pb/Si(111), 50 × 50 nm<sup>2</sup>, V = +2.5V, RT

[1] G. Ménard et al. *Nature Physics* **11**, 1013 (2015)

[2] Braunecker, et al. *Phys. Rev. Lett.* **111**, 147202 (2013)

[3] T. Zhang et al. *Nature Physics* **6**, 104 (2010)

[4] C. Brun et al. *Nature Physics* **10**, 444 (2014)

[5] Franke et al. *Science* **332**, 940 (2011)