NANOSTRUCTURING ORGANIC MATERIAL

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In the last years, an intensive research has been focused on organic materials with promising applications in optoelectronic devices [1]. These materials incorporate interesting properties such as self-organization, flexibility, new electronic (semiconducting or metallic) and optoelectronic properties.

On the other hand, a reduction of the dimensionality of materials result in the emergence of new properties, or modification (even amplification) of the existing. Thus, thin films (2D), nanowires (1D) and dots (0D) exhibit new properties due to their low-dimensional character.

In our study we combine both principles by reducing the dimensionality of organic materials. We show that we are able to form nanostructures with organic molecules on a surface by means of self-organization processes. To achieve this, we used the nanostructure induced on the Au(111)(22×√3) surface by room temperature deposition of iron (<1ML). Fe-islands are formed at the edges of the reconstruction [2] developping the ordered network of metallic Fe islands as shown in Figure 1.

We have deposited PTCDA molecules (3,4,9,10 perylene tetracarboxilic dianhydride) on the ordered arrays of Fe/Au(111). PTCDA exhibits a high mobility on gold at room temperature, forming ordered (self-organized) molecular layers with a “zig-zag” periodicity [3]. The PTCDA molecules deposited on the Fe/Au(111) substrate nucleate preferentially around the iron islands acquiring its nanostructure (see Figure 2).

We study these nanostructured systems made of functional organic molecules by means of scanning tunnelling microscopy (STM) and spectroscopy (STS). Spectroscopic images revealed a marked contrast between the molecules. PTCDA molecules appear brighter or darker mainly due to charge transfer with closer iron atoms. We investigate the growth of such systems and how the different parameters (rate, dose, temperature) play a role in the final ordering and properties of these *nanodots*.

References:

[1] S. Forest, "Ultrathin Organic Films Grown by Organic Molecular Beam Deposition and Related Techniques", *Chem. Rev.* 97, 1793 (1997).

[2] B. Voigtländer et al. "Epitaxial growth of Fe on Au(111): a scanning tunneling investigation", *Surf. Sci.* 255, L529 (1991)

[3] T. Schmitz-Hübsch, T. Fritz, R. Sellam, R. Staub, and K. Leo, "Epitaxial growth of PTCDA on Au(111)", *Phys. Rev B* 55, 7972 (1997).

Figures:

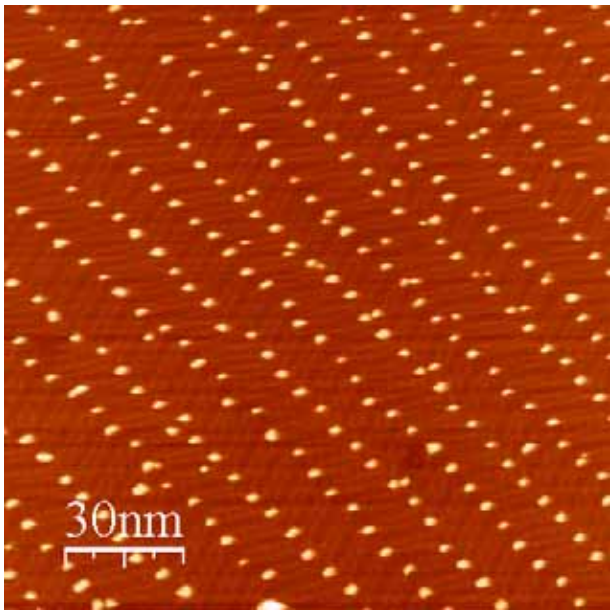

Figure1: Iron islands grown at the edges of the reconstruction Au(111)-(22×√3).

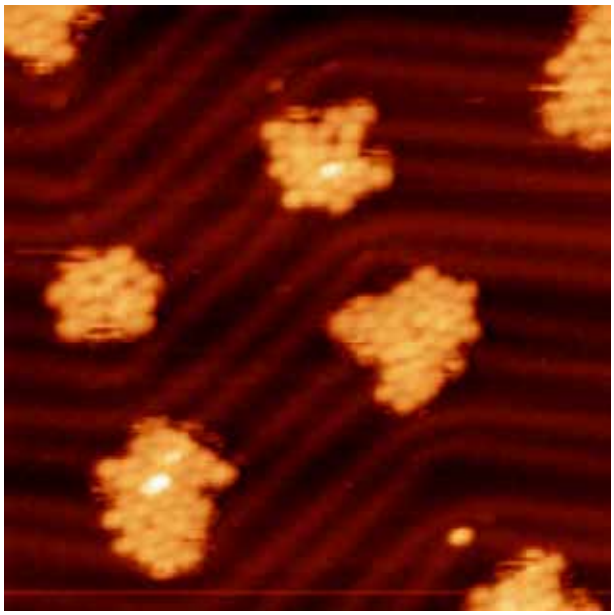

Figure 2: Organic molecules of PTCDA nucleated around the iron islands, nanostructuring the organic material. The tiny lines at the background correspond to the Au(111)-(22x√3) reconstruction.