XPS and STM study of Metal-organic nanostructures

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Nanotechnology is a new and very promising field of science. Nanomaterials are studied looking for new properties derived from the dimensionality reduction. Hybrid materials [1] obtained by a combination of inorganic and organic units, as metal-organic nanostructures [2], present new properties and applications, derived from a combined nature.

In this work, we have performed photoemission spectroscopy (XPS) at the Elettra Synchrotron and scanning tunneling microscopy (STM) on the structures resulting from the combination of iron atoms and organic molecules of PTCDA on a gold substrate.
We have deposited iron on Au(111) in quantities bellow 1 monolayer (ML) and PTCDA organic molecules at low rates. By choosing the adequate growth conditions different systems can be generated: previously reported nanostructures [2], molecular chains and organic nanodots, and extended 2-D structures.

The XPS analysis of the C-1s (see figure 1) and O-1s spectra revealed some changes in the binding energies as well as in the peaks distribution for the case of the formed nanostructures as compared to the PTCDA organic monolayer. On the other hand, the comparison of the Fe-2p spectrum corresponding to 1ML Fe deposited on Au(111) and the nanostructures exhibited no significant changes, even in the oxidation state, which indicates a coordination bond between the iron atoms and the carboxylic group of the organic molecules in the nanostructures formed.

By means of STM, we have focus in the extended structures resulting from two chains connected by perpendicular PTCDA molecules like the rungs of a ladder. These ladder structures can be extended over the entire surface, forming domains. Analysing the images, we can propose models to the structures, some of which have been corroborated by theoretical calculations.

References:

[1] For a review on hybrid materials see for example the special issue: *Journal of Materials. Chemistry* **15** (2005).
[2] J. Méndez, R. Caillard, R. Otero, N. Nicoara, and J.A. Martín-Gago, *Advanced Materials* **18** (2005) 2048-2052.

Figures:

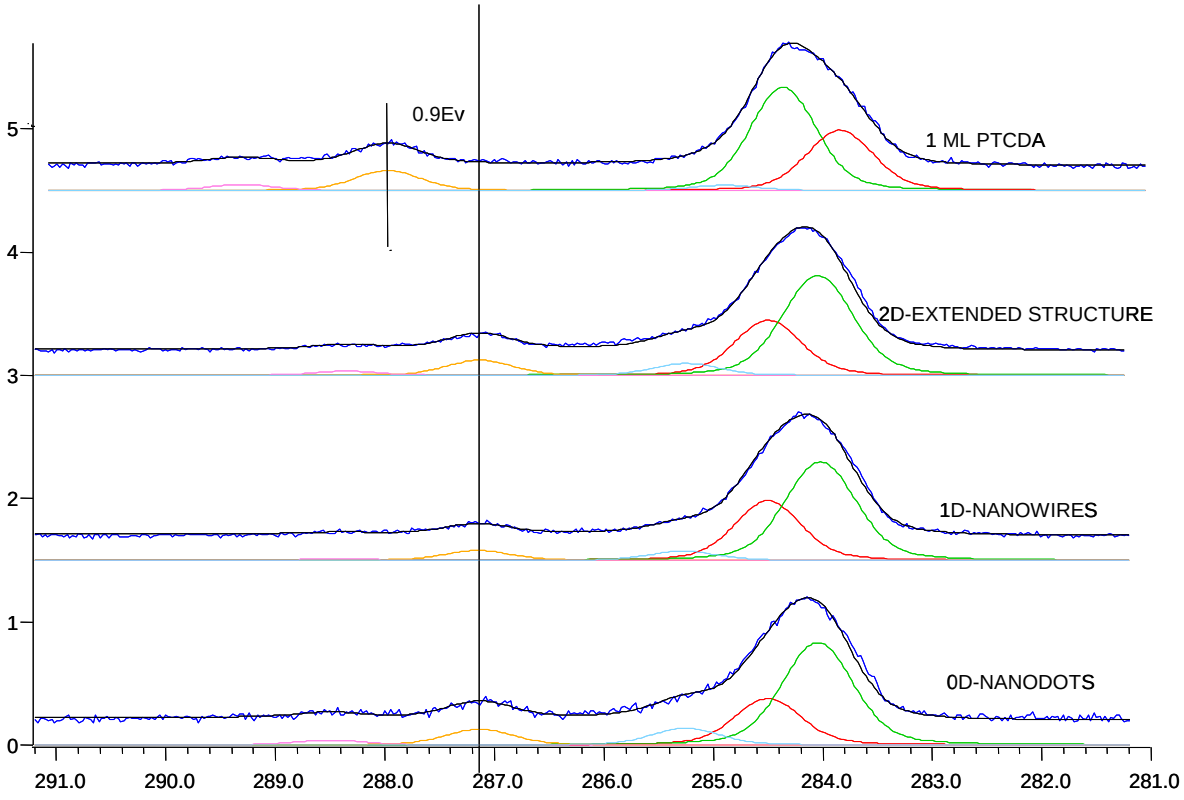

Figure 1. XPS spectra of the C-1s region. Comparison of the C-1s spectra of the metal-organic nanostructures with the spectrum of 1ML of PTCDA, both on a Au(111) substrate. We observe a shift in energy of the functional groups of the nanostructures and a peak redistribution of the perylene components.