3d Self-Assembled Molecular Architectures

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Self-organized systems are in the focus of nanotechnology research because of their potential use in the "bottom-up" development of functional supramolecular structures. The construction of complex assemblies using molecular entities is a key point for the development of novel functional materials. One of the most interesting building blocks, intensively studied in the last decades, are the organic semiconductors, specially poly- and oligothiophenes. A brand new topology, well-defined π-conjugated macrocycles, are of interest as modular building blocks for the assembly of new materials and supramolecular chemistry. They will play an essential role as key components for coming nanoelectronic devices. [1] On the other side due to their toroidal structure, π-conjugated macrocycles could represent intriguing "molecular circuits" which would additionally include sites for recognition and selective complexation. However, the assembly of molecular materials in nanoscale architectures will be a crucial step for the future molecular scale electronics. [2]

In this paper some of the progress of our group analysing by scanning tunnelling microscopy oligo- and polythiophenes adsorbed on surfaces will be presented. The self-assembling properties of the first class of fully conjugated macrocycles, cyclo[*n*]thiophenes, reveals a high crystallinity in the monolayer. [3] 3D Nanostructures can be grown on top of the modified surface in a crystalline matter. The data will be analysed with the help of theoretical conformational and MO analyses. By means of STM, we also investigated epitaxy and interactions of C60-fullerenes with 2D crystalline monolayers of cyclo[*12*]thiophene resulting in perfectly ordered 1:1 complexes (Fig.1). STM-analyses of the nature, specificity and dynamics of the complexation processes taking place at the surface, supported by theoretical calculations, will be discussed. Scanning tunnelling spectroscopy (STS) was performed on such 3D nanostructures.

References:

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Figure 1: 3D-STM image of C[12]T molecules and C[12]T-C60 complexes on HOPG (30 x 24.2 nm^2, -700 mV, 26.5 pA)