SUPRAMOLECULAR SELF-ASSEMBLY ON FLAT AND VICINAL AU(111)

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Molecular structures in the nanometer range exhibit an enormous potential for applications in future electronic data storage and processing devices. Such structures are particularly interesting when created through the process of self-assembly on suitable substrates. Vicinal surfaces with one-dimensional arrays of steps are ideally suited as patterned templates for the mass fabrication of one-dimensional structures on the nanometer scale, where conventional lithographic techniques are no longer feasible or affordable. Our aim is the self-assembly and the nanoscopic characterization of one-dimensional (1D) supramolecular structures, using vicinal surfaces as templates. In particular, Au(111) vicinal surfaces are very suitable templates since they exhibit an extraordinary perfection of the step/facet array that reaches the micron range.

Vicinal Au(111) templates are currently being tested with a variety of molecules, using VT-STM and spectroscopic techniques, such as XPS and NEXAFS. Among these molecules, we have studied the adsorption of fullerene C_{70} on the Au(788) and Au(233) planes of a faceted Au(443) surface (Figure 1). The former posseses a structured fcc/hcp domain along the terraces that act as selective adsorption site, whereas the latter allows molecules to aggregate into elongated hexagonal clusters. We are also testing planar molecules with linear geometry and functionalized end groups, such as imide and amine. In particular, newly synthesized benzodiguanamina and NTCDI, which have been adsorbed alone or co-adsorbed (Figure 2), leading to a variety of two-dimensional and one-dimensional assemblies. In order to understand the hierarchy of driving forces for a particular assembly, we have performed theoretical calculations that take into account the bonding energy between molecules in different geometries and the interaction with the substrate.

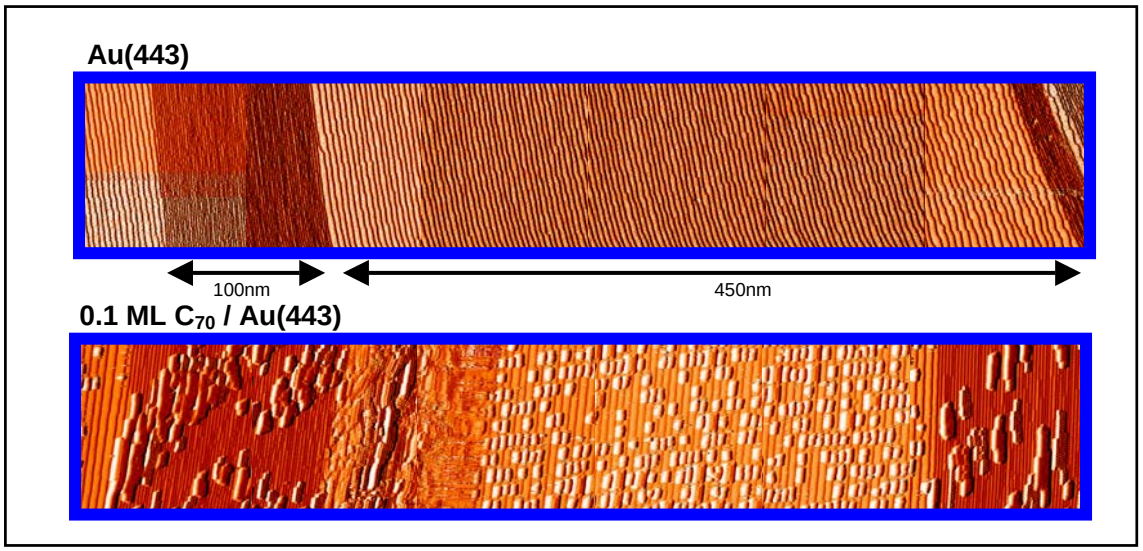
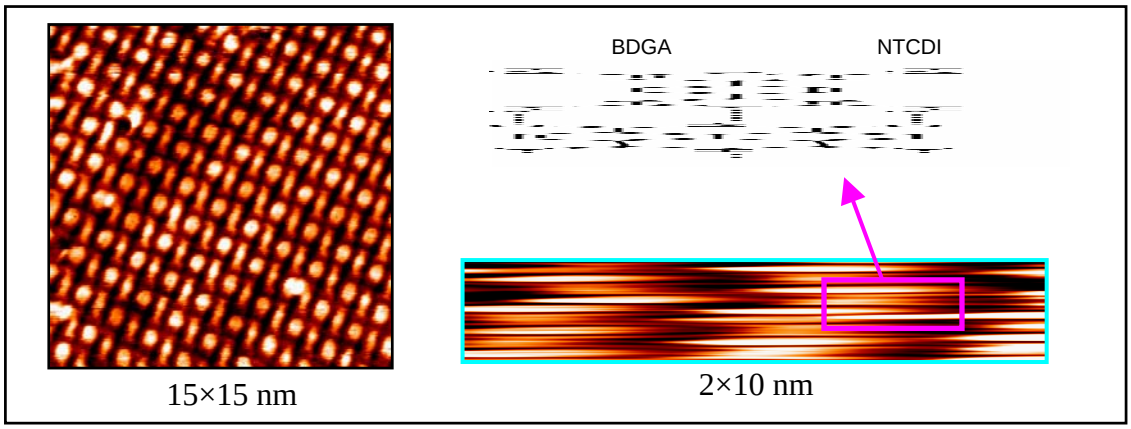


Figure 1: *Top, Au(443) surface showing two different phases, namely 38 Å wide terrace arrays (450 nm) and 12 Å- periodic step bunches (100 nm). Au(443) is used for comparatively testing supramolecular assemblies on vicinal surfaces with distinct step density. On the bottom panel, 0.1 ML adsorption of C_{70} fullerenes lead to either 4-molecule clusters sticked to fcc/like step edges on 38 Å-wide terraces, or to elongated clusters with hexagonal packing on 12 Å wide terraces.*



· **Figure 2**: *Coadsorption of benzodiguanamine (BDGA) and NTCDI on Au(111) leads to a packed structure of molecular chains with alternating BDGA-NTCDI sequence that line up parallel to surface steps. Molecules have been designed and synthesized to allow strong intermolecular H-bonding along the chains, and weak H-interaction across. Each molecule in the sequence can be easily identified in the STM image.*