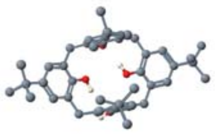
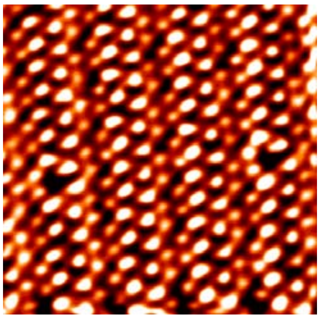
REPORT Calix/Cu(110)

Use of regular nets of molecular magnets is a novel route towards higher density recording media. This implies integrating those magnets in a controlled way into a solid state environment. Until now, all attempts to produce long-range ordered arrays of doped Mn-molecular magnets have failed. Alternatively, the use of organic molecular templates showing long range order can be arranged for later adsorbate depositions. Organic molecules developed in supramolecular chemistry, some of which may host inorganic elements, are ideal candidates for such a purpose. A pre-requisite to the controlled production of such surfaces and characterisation of their magnetic properties (costly in terms of temperature and field), is a better knowledge of their structural arrangement.

In the work performed in June 2006 at BM32_SUV we studied the structural arrangement of 4-tert-butyl-calix[4]arene molecules grown on the unreconstructed Cu(110) as first step before depositing cobalt atoms on a single-layer of these type of films. The molecules, made of four phenol rings linked by methylene groups (see fig.1), offer a high flexibility and, as a consequence, are favourable to yield ordered films on various substrates.





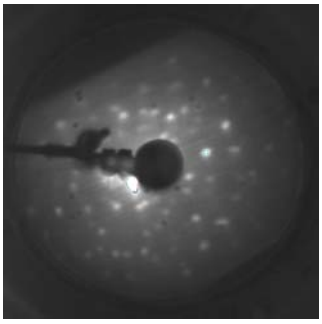


Figure 1: Schematic top view of the 4-tert-butyl-calix[4]arene.
Figure 2: (10 x 10 nm^2) STM image of the molecular template grown on Cu(110).
Figure 3: LEED pattern recorded at 11 eV on the same surface.

A detailed study by Scanning Tunneling Microscopy (STM) and Low Energy Electron Diffraction (LEED) initially revealed perfect self-organized layers of these type of calix[4]arene molecules on Cu(110). Upon molecular adsorption, a rather complex superstructure has been found with the presence of two 22.28º rotated domains around the [1-10] Cu-axis as follows from the LEED pattern of Fig. 3. A high resolution STM image of a single domain is shown in fig. 2: the molecules organize into pseudo-rectangular unit cells with surface lattice parameters a=9.67 Å, b=15.74 Å and γ=91.83º as determined from GIXRD experiments. The experiment performed at BM32-SUV beamline permitted the recording of more than one thousand symmetry independent reflections from the calix[4]arene type of superstructure. Moreover, 8 crystal truncation rods (CTR's) were also measured to permit the location of the molecules respect to the Cu-substrat.

The 2D arrangement is mainly driven by hydrogen bonding between the molecules which suffer a large distortion to get close packed onto the surface [V. Langlais et al., PR B (2006) (in press)]. Fig. 4 shows a X-ray directional K-scan of the (1,0,0.05) reflection becoming to the molecular surface arrangement of the 4-tert-butyl-calix[4]arenas superstructure. The FWHM of this peak indicate terrace sizes larger than 2000 Å. Due to the short period of time from the experiment to now, no definitive results can be provided, however, since the data is still being processed.

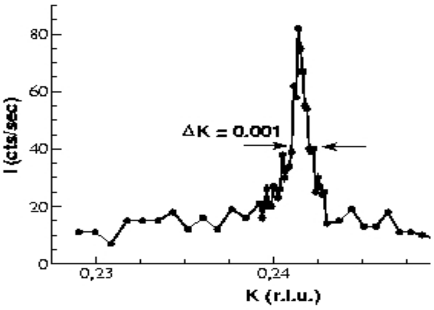


Figure 4. Directional K-scan corresponding to the (1,0,0.05) reflection of the 4-tert-butyl-calix[4]arene surface arrangement.