Introduction to Scanning Probe Microscopies

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These practical works are an introduction to Scanning Probes Microscopies and more precisely to Atomic Force Microscopy (AFM) and Scanning Tunnelling Microscopy (STM). At the end of these practical sessions, the participants will have a basic knowledge of the possibilities offered by these two techniques for imaging surfaces and also for characterizing locally the physical properties of nano and micro-objects. These practical works are made of two sessions of four hours each (one day). Depending on the background and interests of the participants, these sessions can focus more on some of the following aspects:

1. **AFM**

- Imaging surfaces in contact mode or dynamic mode: patterned silicon surface, graphite mono-atomic steps, gold nano-particles on graphite substrate (Fig 1b), CD and DVD optical disc.
- Distance spectroscopy in contact mode or dynamic mode: approach-retract curves on silicon, capillary force, electrostatic force.
- Morphology maps combined to mechanical maps of a mixture of two polymers (LDPE micro-particles embedded in a matrix of polystyrene) in “Peak Force” mode (Fig 1d).
- Injection and detection of electric charges by EFM in Si dots embedded in a SiO_2 layer.
- Imaging magnetic materials by MFM: hard discs and FePt layers (Fig 1c).
- Imaging biological cells on a patterned substrate (Fig 1e). -only available on certain days-.
- Nano-lithography by AFM (Fig 1f): local oxidation of hydrogenated silicon surface (only available on certain days).

2. **STM**

- Imaging graphite surfaces and Graphene layers on SiC substrate: atomic resolution, atomic steps, terraces, Moiré observation and characterization (Fig 1a).
- Current versus voltage and current versus distance spectroscopy on graphite.

Four commercial microscopes working at room temperature in air will be available:
AFM Dimension 3100 (Veeco), AFM Dimension ICON (Bruker), NanoWizard AFM (JPK) combined with a fluorescence microscope, STM (Nanosurf).

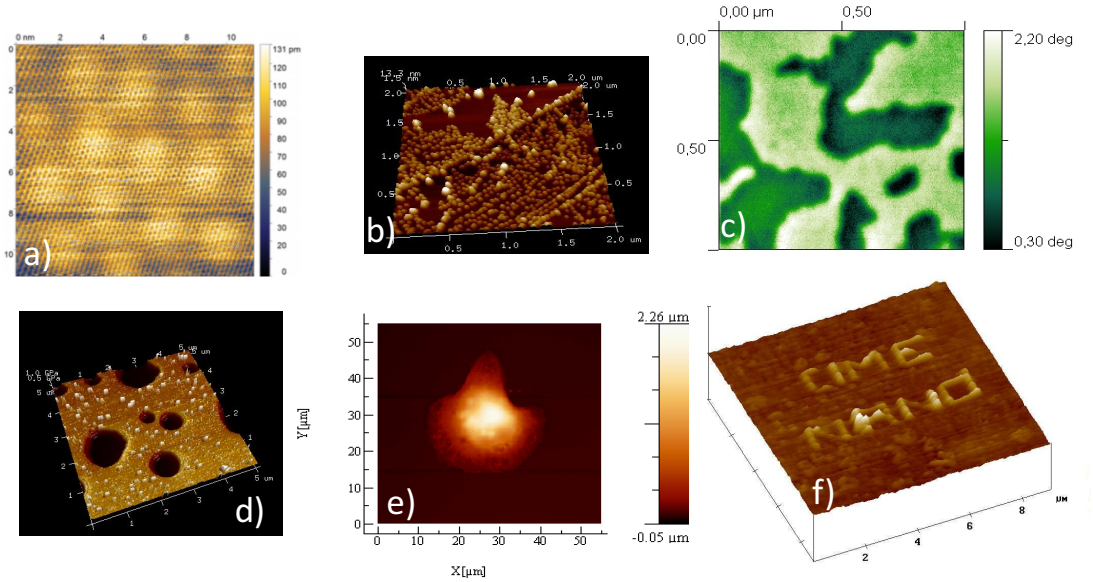

Figure 1 : (a) STM Topography image of Moiré and atomic arrangement of graphite on SiC surface, (b) AFM image of NP on Highly Oriented Pyrolytic Graphite surface ; (c) MFM image of Fe/Pt surface ; (d) AFM Image Young modulus variation of LDPE/PS sample ; (e)AFM Topography image of osteoblast cell fixed on a CYTOO Fibronectin pattern ; (f) AFM image of nano-oxidation of CIME logo induced by AFM tip on Si-H surface. All images have been obtained with the AFM and STM instruments available on the Nanoworld platform.