Nanostructures at Surfaces laboratory at Sapienza

The aim of the laboratory is to investigate how physical properties arise when solid state systems shrink to the nanoscale. It is mainly devoted to atomic level controlled growth of molecular systems, low dimensional structures with desired morphology and spacing on suitable nano-structured templates. A special effort is dedicated to the growth of graphene on metallic substrates via chemical vapour deposition, graphene nanoribbons by molecular precursors, graphene nano- and micro-porous systems (see Fig. 1, right panel). Of the nanostructures grown on surfaces we study: (i) the bonding state of the elements by means of X-ray photoelectron spectroscopy (XPS), (ii) the 2D crystalline order by low-energy electron-diffraction (LEED), (iii) the control of the growth morphology by Auger electron spectroscopy (AES), and (iv) the adsorption energy by thermal desorption spectroscopy (TDS).

The XPS, LEED/AES and TDS apparatus is contained into an ultra-high-vacuum (UHV) chamber, UHV-connected to a small chamber for a fast load-lock introduction, along with several other characterisation methods and ancillary facilities for samples preparation and cleaning, atomic/molecular beam epitaxial evaporators.

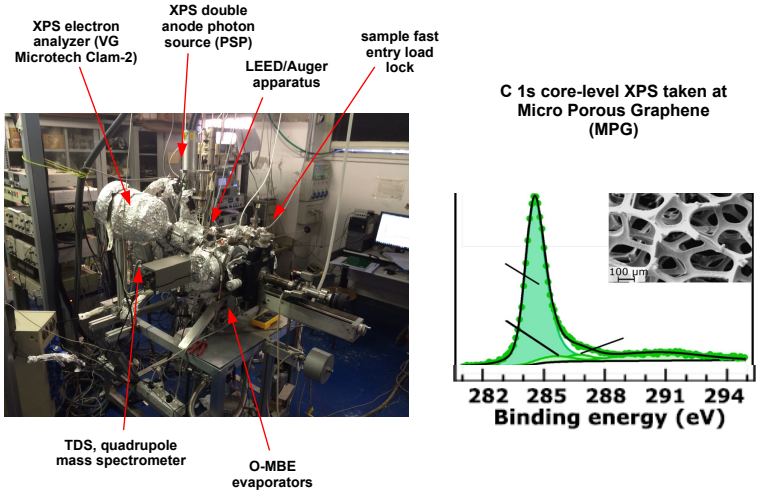

Figure 1: Left: XPS and growth chamber (5×10^{-11} mbar base pressure). Right: XPS C 1s core-level at MPG.

In the following, the main characteristics of the apparatus.

- XPS hemispherical electron analyser: VG Microtech Clam-2, pass-energy range: 10-200 eV, single-channel detector;
- XPS photon source: PSP double-anode X-ray source, emission lines Al_{K_α} (1486.6 eV) Mg_{K_α} (1253.6 eV);
- XPS UHV manipulator: 4-degrees of freedom, cryostat (>77 K), electron-bombardment heater ($\leq$1200 K);
- Low-Energy Electron Diffraction (LEED): Omicron SpectaLEED system, with LEED and Auger modules;
- Ion Gun: Omicron ISE10 0.2-5 keV energy range, Ar ion source;
- Mass Spectrometer: residual gas analyser SRS RGA (1-300 a.m.u.); linear T ramp for TDS acquisition;
- Gas line equipped with several ports, UHV-connected through a leak-valve to the main chamber; O, H and C_2H_4 sources;
- Organic-molecular beam epitaxy (O-MBE) cells, with thermocouple control; quartz crystal thickness monitor; high-temperature electron-bombardment based evaporator for transition metals.

References I. Di Bernardo *et al.*, ACS Omega **2** 3691 (2017); Carbon **131** 258 (2018); M. Iacobucci *et al.*, Nanotechn. **29** 405707 (2018); G. D'Acunto *et al.*, Carbon **139** 768 (2018); F. Leardini *et al.*, 2D Mat. **6** 035015 (2019).

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