Nanostructures at Surfaces laboratory for angle-resolved photoelectron spectroscopy (ARPES) at Sapienza

The laboratory is devoted to the experimental investigation of the electronic band structure of surfaces and two-dmensional (2D) materials by means of high-resolution angle-resolved ultraviolet photoelectron spectroscopy (ARPES). The ARPES apparatus, working at high energy and angle resolutions, operating at low temperatures, is contained into an ultra-high-vacuum (UHV) chamber, UHV-connected to a preparation chamber equipped with several other characterisation methods and ancillary facilities for samples preparation and 2D materials growth, and is provided with a small UHV chamber for a fast load-lock introduction (Fig. 1, left panel).

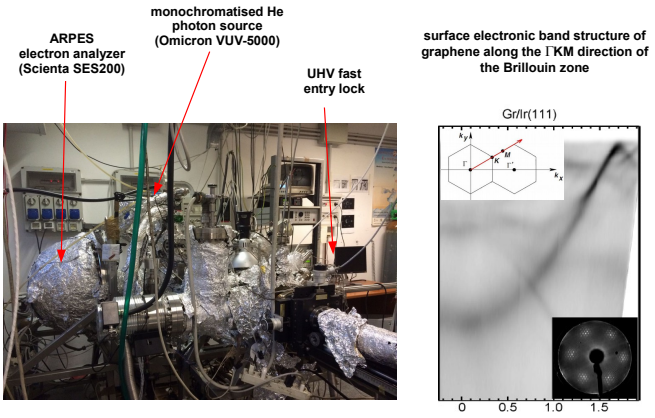

Figure 1: Left: ARPES chamber (1×10^{-10} mbar base pressure). Right: Electronic band structure of graphene (Gr) for Gr/Ir(111), along the ΓKM direction of the suface Brillouin zone, excited with the HeI_α photon energy (21.218 eV).

In the following, the main characteristics of the apparatus:

- ARPES hemispherical electron analyser: Scienta SES-200, 4 meV best energy resolution, <0.1° angular resolution, 1-50 eV pass-energy range, multi-channel detector (MCD, ±8° angular span and 10% of pass-energy energy span); Graphene band structure in Fig. 1, right panel;
- ARPES photon source: Omicron-Scienta VUV-5000 monochromatised MW-excited He source, main lines HeI_α at 21.218 eV and HeII_α at 40.814 eV, up to HeII_δ at 52.241 eV;
- ARPES manipulator: 5-degrees of freedom UHV manipulator, with precision rotation of the azimuthal and polar angles, cryostat to liquid nitrogen temperature, electron-bombardment heater up to 1200°C;
- Low-Energy Electron Diffraction (LEED): Specs retractable ErLEED 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 300, 1-300 a.m.u. range;
- Gas line, equipped with several ports for small bottles and UHV-connected through a leak-valve to the main chamber; oxygen and C_2H_4 sources mounted, the latter for graphene preparation on metals *via* temperature programmed growth;
- Organic-molecular beam epitaxy (O-MBE) cells; high-temperature electron-bombardment based evaporator for transition metals; quartz crystal thickness monitor; cleaver, other ancillary facilities for sample preparation, etc.

References I. Di Bernardo *et al.*, ACS Omega **2** 3691 (2017); I. Di Bernardo *et al.*, Carbon **131** 258 (2018).

`https://sites.google.com/uniroma1.it/nano-surface-physics/home`