New nano-probe for electronic and chemical imaging of 2D materials beyond graphene

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Recently, remarkable progress has been achieved in modern microscopies. However, even if they have attained exceptional lateral resolution, the problem of providing powerful spectroscopic and electronic characterization at the nano- and mesoscopic-scale still remains. This gap is particularly filled by an innovative and powerful technique named k-space nanoscope or NanoARPES (Nano Angle Resolved Photoelectron Spectroscopy). This cutting-edge nanoimaging technique is able to determine the momentum and spatial resolved electronic structure, disclosing the implications of heterogeneities and confinement on the valence band electronic states typically present close to the Fermi level. The k-space nanoscope can be effectively combined with chemical imaging based on core levels (and their chemical shifts) scanning photoemission and X-ray absorption able to detect even very tiny different chemical environments.

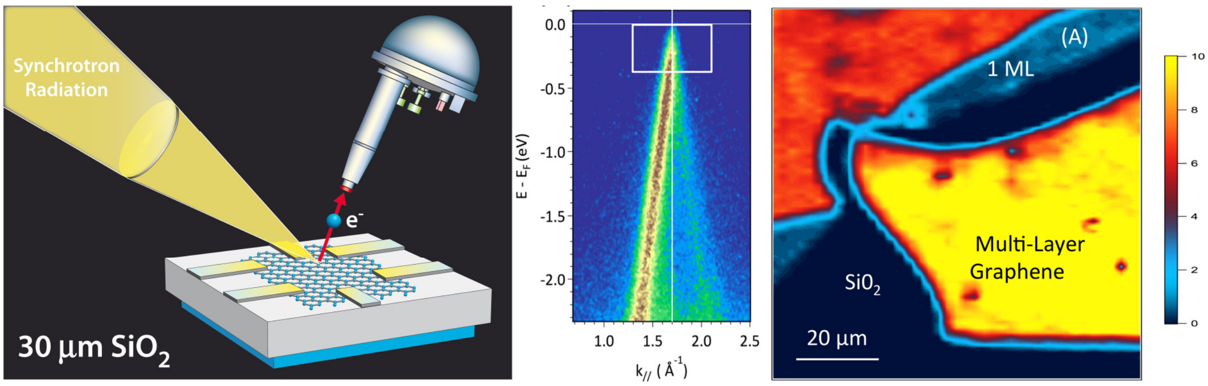

Fig.1. Real-space image and nano-ARPES electronic band dispersion of single- and multi-layer graphene films on SiO_2 substrate. Left panel, scheme of the Nano-ARPES apparatus, middle panel Nano-ARPES data recorded at the "A" position of the image (right panel).

In this presentation, the more relevant results in the field of chemical and electronic imaging of 2D materials using k-space nanoscope will be disclosed, highlighting the basic principles, associated instrumental and appealing scientific cases. In particular, nanoARPES findings describing the electronic band structure of mono-atomic exfoliated graphene on SiO_2 substrates, epitaxial and polycrystalline monolayer graphene films grown on copper and SiC [1,2] will be presented and Graphene/MoS_2 heterostrustures. Electronic and chemical mapping with high energy, momentum and lateral resolution have provided relevant features like gap-size, doping, effective mass, Fermi velocity and electron-phonon coupling, among other properties for diverse 2D materials [3-6]. Finally, special mention will be devoted to the recently reported results on the spin-charge separation in metallic MoSe2 grain boundary [7].

References

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