Surveying Electronic Structure of CVD graphene on polycrystalline copper foils by nano-ARPES

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In today's state-of-the-art ARPES, probed areas are routinely in the range from tens to hundreds of microns. Notwithstanding in advanced materials, length scales from the nano- to the mesoscopic scales dictate and characterize the electronic and other relevant properties. Thus it is not possible access relevant length scales for many complex engineered materials using conventional ARPES. At the Synchrotron SOLEIL, we have recently built a new instrument by combining ARPES principles with scanning microscopy, in which a focused soft x-ray beam is raster-scanned over the samples to create an image one pixel at time while a suitable signal is monitored under computer control. We detect the photoelectron signal with cutting-edge hemispherical photoelectron spectrometer capable of extremely high momentum and energy resolution. This new nano-probe is capable of investigating innovative materials in their earlier stage of synthesis, which often are initially isolated in small crystalline form or in polycrystals constituted by small grains.

During this contribution, we will disclose the latest nano-ARPES results, obtained by our group at SOLEIL, related to the granular structure of monolayer graphene samples grown by chemical vapour deposition (CVD) on polycrystalline copper foils. We have explored the Dirac cone of individual grains as well as we have obtained net images of the distribution of the grains inside and at the copper grain boundaries. The preferential orientation of the graphene grains relative to the copper substrate has also been established. Moreover, the crystalline quality of the copper grains has been evidenced by nano-ARPES images. The doping and the Fermi velocity of individual graphene grains have been unambiguously assessed from the direct determination of the Dirac cone in single graphene grains.