Dark Field Photoelectron Emission Microscopy of Micron Scale Few Layer Graphene

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We present dark field Photoelectron Emission Microscopy and energy filtered electron emission spectromicroscopy with high spatial and wave-vector resolution on few-layer epitaxial graphene on SiC(000-1) grown by furnace annealing.

Conventional electron spectroscopy methods are limited in providing simultaneous real and reciprocal or k-space information from small areas under laboratory conditions. Therefore, the characterization of materials with only micron scale sample homogeneity such as epitaxially grown graphene requires new instrumentation. Recent improvements in aberration compensated energy-filtered photoelectron emission microscopy (PEEM) can overcome the known limitations in both synchrotron and laboratory environments.

Energy-filtered, threshold PEEM is used to locate distinct zones of FLG graphene. In each region, selected by a field aperture, the k-space information is imaged using appropriate transfer optics. By selecting the photoelectron intensity at a given wave vector and using the inverse transfer optics, dark field PEEM gives a spatial distribution of the angular photoelectron emission. Only the combination of high lateral, high energy, high k-resolution and controlled switching between real space and k-space allows detailed understanding of micron size sample sites with 1–3 layers graphene.

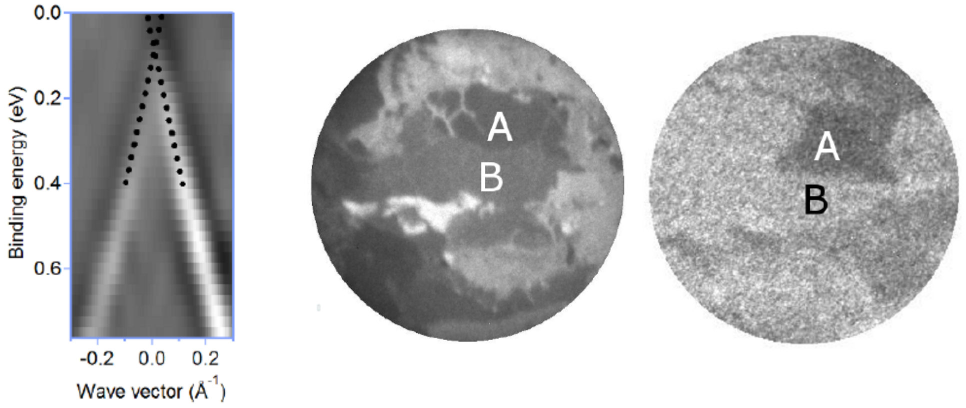

Figure 1: Photoemission data excited by a laboratory VUV light source (He I). Left: high resolution π band dispersion of the Dirac cone obtained by a cut through the K point, perpendicular to Γ-K. Centre: 35µm FoV Real space threshold image at E-EF = 5.225 eV. Right: 35µm FoV dark field real space image E-EF = 18.0 eV obtained after positioning a contrast aperture with a diameter of 0.53Å^{-1} around a specific Dirac cone allows to image areas on few layer graphene which have the same orientation and layer thickness.