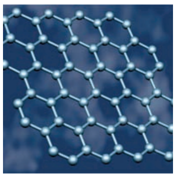
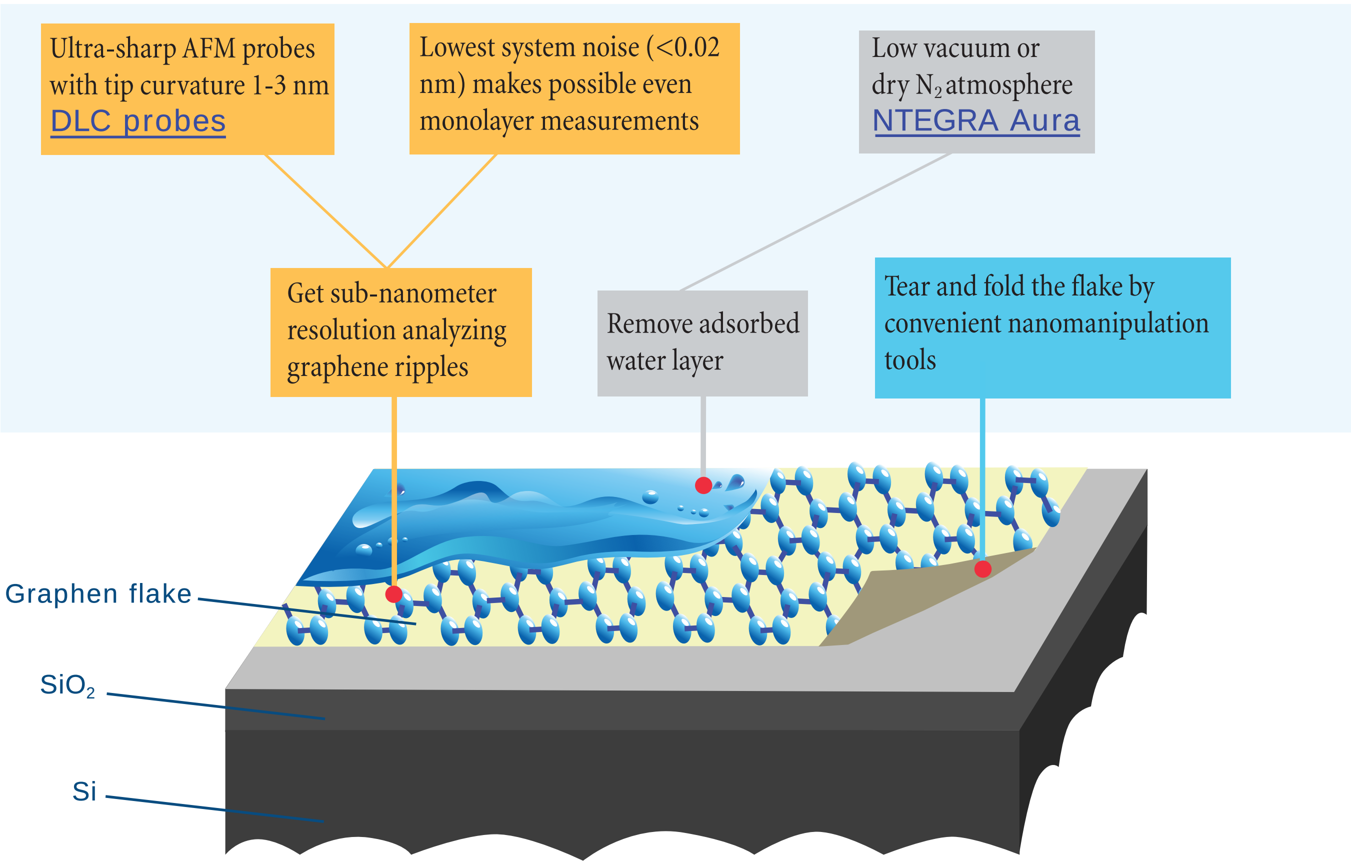


Graphene digest

The interest in graphene is continuously rising among science communities. Applied physicists, new material designers, and nanotechnology engineers are attracted by its unique properties such as electrical and thermal conductivity. Fundamental physicists are enchanted by the possibility of exploring quantum relativistic phenomena on 2-dimentional crystals that have an unusual electronic spectrum. In order to manipulate a single-atom-thin structure, you need a reliable high precision tool.

In this digest two experimental examples are presented. The first one, shows the advantages of the NTEGRA-based AFM and how it can reveal the fine structure of graphene flakes. The second example, shows how the NTEGRA combines SPM with Raman spectroscopy to become a NanoLaboratory with advanced analytical capability.

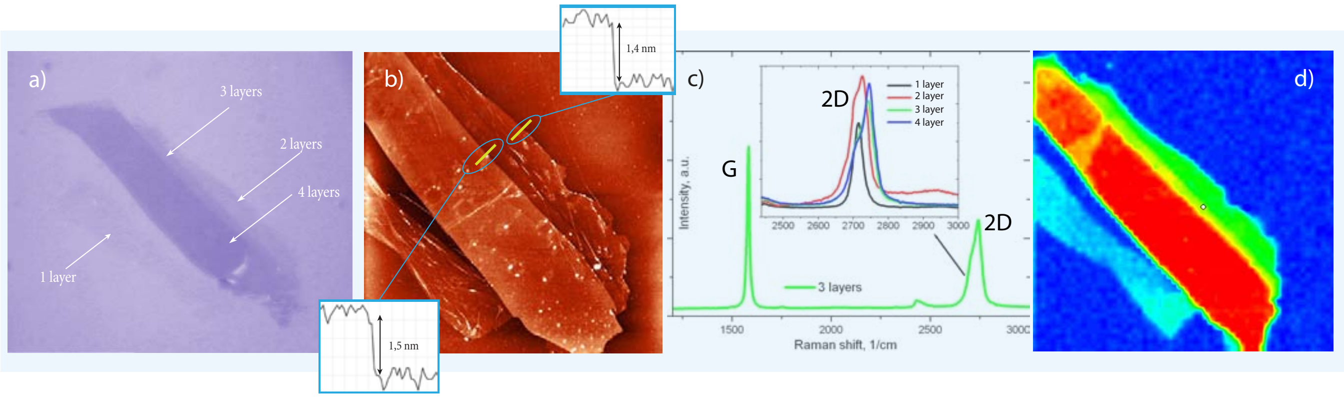
AFM experiments*



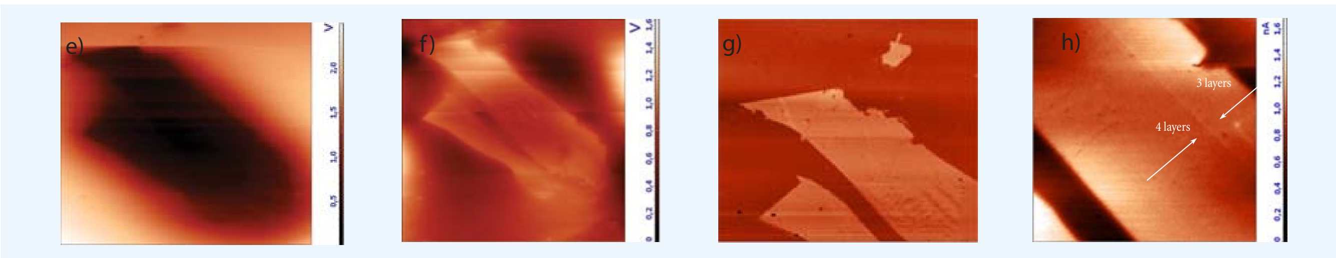
* Details of original experiment see in Tikhonenko et al. Weak Localization in Graphene Flakes// Phys. Rev. Lett. 100, 056802 (2008).

Complex experiment: Raman Spectroscopy + SPM NanoLaboratory NTEGRA Spectra

The powerful analytical capabilities of scanning probe microscopy and Raman microscopy have been successfully integrated with NTEGRA Spectra NanoLaboratory. The NTEGRA Spectra provides a comprehensive characterization of the graphene specimen. Shown are images and quantitative data obtained from the same graphene sample (placed on Si/SiO2 substrate) obtained in a single experiment using the AFM – Raman setup.



a) White light image of multi-layer graphene sample obtained with high resolution 100x, 0.7 NA objective. 1-, 2-, 3-, and 4- layered flakes are observed. Image size 120×110 μm.
b) AFM topography of the same sample with corresponding line profiles. Scan size 50×50 μm.
c) Raman spectra of graphene flakes. 2D (G') Raman peak changes in shape width and position for an increasing number of layers reflecting a change in electron band structure.
d) Confocal Raman map (2D band center of mass position). 1-, 2-, 3-, and 4- layered flakes can be easily distinguished when using a color palette scale.



e) and f) Scanning Kelvin probe microscopy of negatively and positively charged graphene. The flakes were charged by applying +3V e) or -3V f) voltage with conductive cantilever. Scan size 90×80 μm.
g) Electrostatic force microscopy of the same sample. Scan size 65×55 μm.
h) Scanning capacitance microscopy image. Singularity in capacitance distribution can be seen at the edge of the layer reflecting graphene electron edge states. Scan size 25×25 μm.