GRAPHENE@NEST: ONGOING RESEARCH ACTIVITIES ON GRAPHENE AND ARTIFICIAL GRAPHENE

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I will review in this talk the research activity on graphene at the National Enterprise for nanoScience and nanotechnology (NEST) in Pisa (Italy).
More in detail, I will present the first experimental work related on the visibility of graphene on SiO_2 substrate [1], theoretical studies on the electronic structure and Peierls instability in graphene nanoribbons sculpted in graphane [2], and our research activities on ultra high-quality graphene layers found on selected regions of bulk graphite, in which the Dirac fermions are characterized by large lifetimes and [3] (see Fig.1a). I will also briefly address our recent results on "artificial graphene structures", created in modulation-doped GaAs semiconductor heterostructures by nanofabrication [4] (see Fig.1b,c). In this system a lateral superlattice with honeycomb symmetry is obtained by e-beam lithography and dry etching [5, 6]. Formation of linearly dispersing Dirac bands and collective phenomena will be discussed.
Finally, I will focus on our latest results on high-resolution scanning probe and electron microscopy on graphene: blistered nanostructures on single layer graphene deposited by a PDMS-based transfer printing method [7](see Figure 2a), nanopatterning by electron-beam induced etching (EBIE) employing oxygen radicals and ozone (see Figure 2b), spatially-resolved oxidation-reduction processes on SiC-grown graphene, and UHV scanning tunneling experiments and theoretical predictions on atomic hydrogen chemisorption kinetics, by exploiting and controlling the corrugation of graphene layers [8].

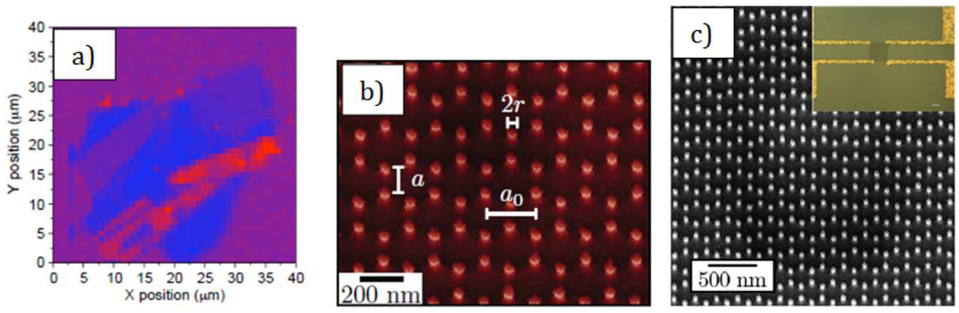

Figure 1: (a): map of the ratio of intensities of the 2D double peak structure of a Kish graphite flake, obtained by integrating over energy ranges centered on the two components of the 2D peak: variations of the intensity of the two peaks is a clear indication of the irregular single layer contribution to the Raman signal. (b): Scanning electron microscopy image of the nanopatterned modulation-doped GaAs/AlGaAs sample, the "artificial graphene" structure. (c): Scanning electron microscopy image of the nanopatterned modulation-doped GaAs/AlGaAs sample with honeycomb geometry. The inset shows a picture of the device with four Ohmic contacts.

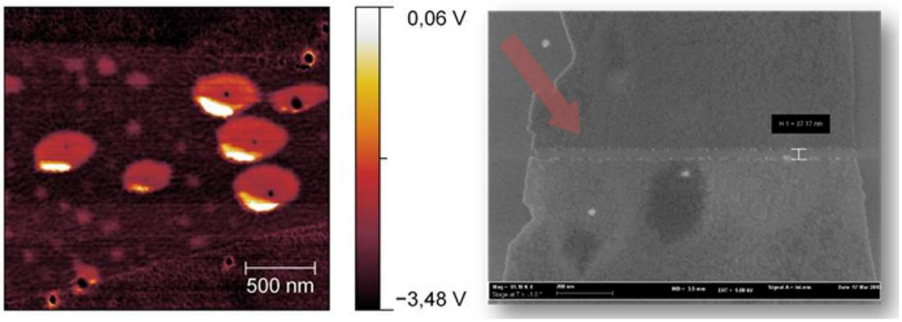

Figure 2: (a): SPM phase imaging of "blistered graphene", showing the high contrast between the blistered regions and the flat one due to a different elastic response: notice in some cases the presence of rigid structure (debris) in correspondence of the central part of the suspended membranes and the rippling of the single layer graphene (SLG) structure. (b) SEM picture of the SLG after the spatially resolved EBIE: the obtained cut has a width of 37 nm and some blisters disappeared, relaxing on the substrate.

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