Fabrication and analysis of defective, amorphous, deformed, strained, functionalized and stacked 2D materials via high-resolution electron and scanned probe microscopies

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Abstract: I will show several recent experiments with 2D materials that have been treated for the generation of defects, synthesized in amorphous form, deformed and strained via local probes, or decorated with molecules. The first part concerns the study of these systems by high-resolution scanning transmission electron microscopy, which reveals structural modifications at the atomic level and also can be used to introduce disorder or even controlled displacements [1-5]. Among other things, we have studied the transition from a crystalline to an amorphous 2D material [2], traced the diffusion of a vacancy in graphene [3], showed a controlled displacement of silicon impurities in graphene [4] and created lateral hetero-structures of ordered and disordered twodimensional carbon [5]. I will also show a new approach to image radiation-sensitive molecular species on graphene, based on distributing the dose over many identical structures [6], besides sandwiching and using low energies. In the second part, I will discuss a novel approach to study free-standing membranes by dual-probe scanning tunneling microscopy (STM), where two STM tips are brought into contact with the graphene membrane from opposing sides. At the closest point, the two tips are separated only by the thickness of the membrane. The interaction of the two probes across the membrane provides insights to both the membrane properties as well as to the fundamental interactions between the probe and the material [7].

References

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