INTERFEROMETRIC TEM INVESTIGATION OF GRAPHENE MEMBRANES

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Graphene is a two-dimensional crystal of carbon atoms arranged in a honeycomb lattice, and this peculiar atomic structure provides this material with unusual and interesting physical and chemical properties, like extremely high electronic carriers mobility, low spin-orbit coupling and ultimate mechanical stiffness [1]. The characterization of the structural and electronic properties of graphene membranes is the subject of an intense study by the material science community since its isolation in 2004, and transmission electron microscopy (TEM) established as an essential tool due to its elevated spatial resolution and sensitivity [2, 3].
We will present our recent results on the structural and electronic characterization of graphene membranes, using advanced low-voltage aberration-corrected interferometric TEM methods, like electron holography [4] and Geometric Phase Analysis [5]. In particular, we will show that electron holography has been pushed to its actual resolution limits to map the distribution of electrostatic crystal charges in individual graphenes, and to investigate valence charge redistributions due to inter-layers bonding and surface atoms under-coordination in few-graphenes membranes and carbon nanotubes. We will also present a novel method for the 3D reconstruction of few-graphenes membranes folds and undulations, providing maps of sub-nanometric height variations from the Geometric Phase Analysis of the apparent lattice deformations in individual high-resolution images of the membranes.

References

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