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Photoemission and x-ray absorption of graphene/h-BN multilayers grown by ion-beam-assisted deposition

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There is an increasing interest in heterostructures made from alternating layers of graphene and hexagonal boron nitride (h-BN), the latter being the optimal dielectric substrate for use in graphene based devices due to their similar structure. To fabricate graphene and h-BN ultrathin layers, we performed sequential evaporation of carbon and boron assisted with low energy nitrogen ions, using an ion beam assisted deposition (IBAD) system with optimized operation for subnanometric layers. This setput was used previously to produce nanometric carbon/h-BN multilayers [1].
In order to obtain quasi-epitaxial growth in this challenging system, a number of specific problems must be solved, which have been addressed in our research using x-ray absorption near edge spectroscopy (XANES) and x-ray photoemission (XPS). The measurements were conducted at BESSY synchrotron facility using beamline PM4.
Regarding the boron nitride growth, we have studied the texture of h-BN films XANES at different angles of incidence, obtaining a map of basal plane orientation as a function of growth conditions. Also, the amount of vacancy defects and the bond order can be determined from XANES and XPS spectra. The same stands for the graphene growth, which is studied via C(1s) XANES and XPS. In addition, some results are derived on the interfacial interaction between carbon and h-BN layers in the stacking. The synchrotron results are also compared with the more conventional infrared and Raman spectroscopies.

References

[1] R. Torres et al. "Reversed texture in nanometric carbon/boron nitride multilayers"Carbon 74 (2014) 374-378

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