

Towards characterization of graphene using hybrid metrology approach at LNE

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Graphene attracts LNE's interest for more than 10 years as it is today the most promising material to establish a practical traceability for electrical resistance to the quantum Hall effect [1]. Beyond, graphene can have many innovative applications the development of which needs accurate control of the material properties.

To support the expected disruptions and favour the adoption of the graphene-based technologies by industry, LNE which is the French national metrology institutes has made available its CARMEN platform to provide the different actors with dedicated instrumentation for the accurate characterization of nanomaterials. This platform is integrated in the recently inaugurated LNE Nanotech Institute and gathers experts and relevant instruments for nano-characterization like AFM (Atomic Force Microscope), Metrological AFM to provide traceability of dimensional measurement at the nanoscale to the International System of units SI [2], SEM (Scanning Electron Microscope), Confocal Raman Microscope, SMM (Scanning Microwave Microscope), conductive AFM fitted with Resiscope module, SThM (Scanning Thermal Microscope).

As a preliminary work on graphene-based materials, all the available various techniques have been investigated to characterize the same area of a given graphene sample and have been tested for the assessment of the contamination level and the number of layers. The chosen multidisciplinary approach aims at combining several techniques to collect a maximum amount of information on the studied sample and to determine critical

parameters through a hybrid metrology approach.

In addition, as national metrology laboratory and internationally recognized testing laboratory, LNE offers its full calibration and measurements capabilities to characterize and validate graphene-based products, from materials to manufactured products (performances, lifecycle, etc)

References

- [1] R. Ribeiro-Palau *et al.*, Nature Nanotech., 10, 965 (2015)
- [2] S. Ducourtieux *et al.*, Meas. Sci. Technol. 22 (2011) 094010.

Figures

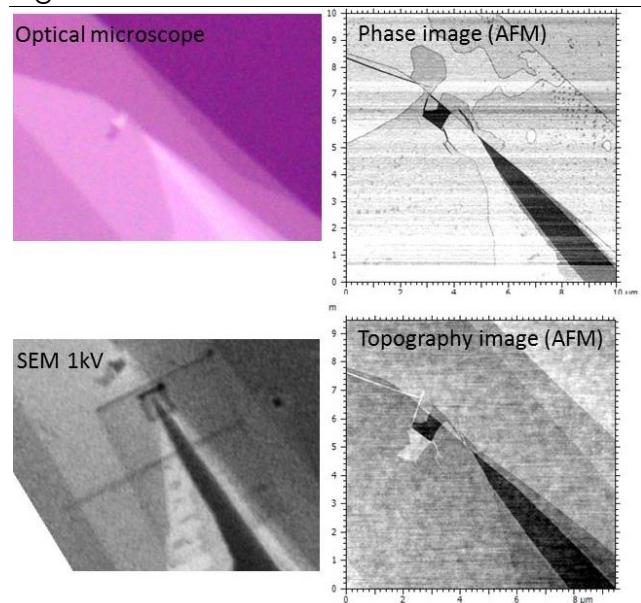


Figure 1: default colocalization on exfoliated graphene using optical microscopy, SEM and AFM

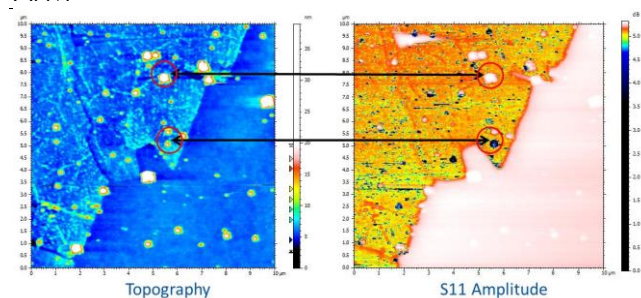


Figure 2: contrast obtained using the SMM at the transition between substrate and CVD graphene layer