Supporting industrialisation of graphene and related materials through reliable and accurate measurement services

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LNE – Laboratoire National de métrologie et d'Essais, is the French National Metrology Institute (NMI) and an internationally recognized testing laboratory. The laboratory is committed to make the most of its capabilities and expertise to facilitate the industrialisation and commercialisation of products based on graphene and related materials (GRM), by providing reliable and accurate measurements for performance evaluation and risk assessment regarding EHS aspects. LNE capitalizes on more than 12-year long graphene technology research for the development of SI quantum electrical standards, and is expert in the specific metrology appropriate to the field of nanotechnologies. Of utmost importance for the services proposed for GRM are the independence, impartiality and trusted third-party status of LNE.

More specifically, the laboratory makes available its comprehensive range of verified instruments and validated methods for measurement of structural, mechanical, thermal, electrical, optical and chemical properties of GRM (flakes, films, coatings, powders, dispersions, composites, etc), as well as their reliability, ageing, and lifecycle, in certain cases. Acting as member of the Graphene Flagship Validation Service, LNE also contributes to several initiatives related to metrology and standardization for GRM at *e.g.* ISO, IEC, VAMAS, EMPIR.

In this presentation, we will show case studies. Some highlight the advantage of combining several techniques to get reliable and accurate measurement of GRM, *e.g.* for measurement of few-layer graphene thin films using AFM, SEM, EDS, Scanning Microwave Microscopy, Scanning Thermal Microscopy, Modulated Photo-Thermal Radiometry. Others on mechanical properties of graphene composites have been performed in compliance with well-established standards. Regarding graphene powders, we will also report progress on metal impurities measurement by ICPMS - Inductively Coupled Plasma Mass Spectrometry and specific surface area measurement by BET - Brunauer Emmett Teller method.

Figures

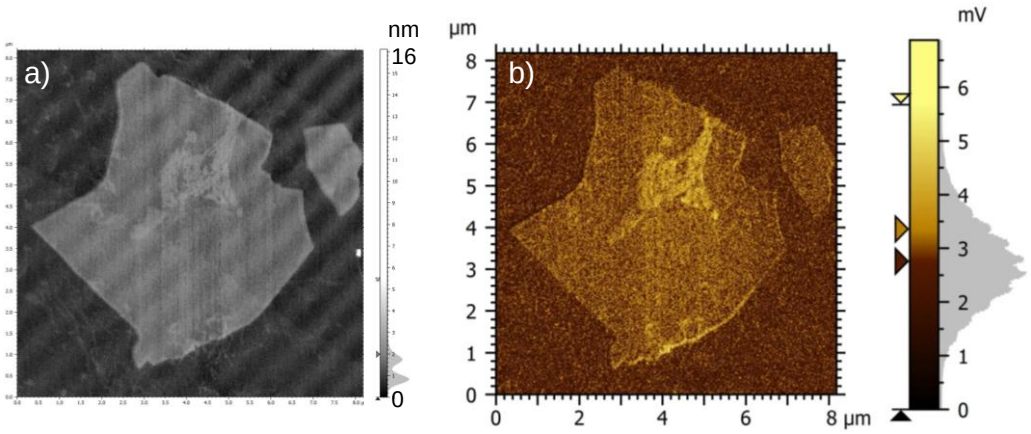

Figure 1: Imaging of GO flakes on mica. (a) AFM topography. (b) Thermal mapping by Scanning Thermal Microscopy (voltage unbalance of the resistance bridge allowing identification of areas with contrasted thermal behaviours).