



Graphene and related 2D materials

Technical Work Area 41

Project 12

Distribution of lateral size and thickness of few-layer graphene flakes using SEM and AFM

Objectives

The aim of this international interlaboratory comparison is to determine the lateral flake size distribution of graphene nanoplatelets (GNPs) using scanning electron microscopy (SEM), and correlate these to measurements of lateral flake size and thickness, using atomic force microscopy (AFM).

The results of the study will be used directly for future revision of [ISO/TS 21356-1](#) with a validated measurement procedure. This work is undertaken as part of the EMPIR project [ISO-G-SCoPe](#).

Background

Graphene is an exciting advanced material, present in the form of flakes in powders or liquid dispersions and in larger sheets grown through bottom-up processes. GNPs in flake form are already starting to find commercial application via small-to-medium enterprises (SMEs) to multi-national corporations, for a large range of application areas. There are currently over 100 commercial 'graphene' producers worldwide, including leading graphene producers in Europe, with an 'on paper' offering of materials with vastly different properties and types.

However, many suppliers (and buyers) are hindered due to uncharacterised or poorly characterised material that can be more often graphite rather than GNPs or have large batch-to-batch variations. Products and applications suffer as a result. The aim is to produce validated measurement methods of GNPs.

Standardisation Needs

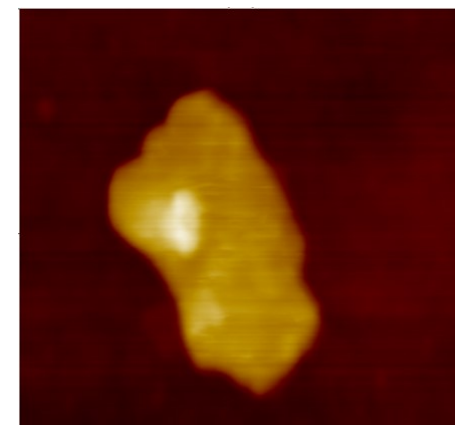
The recently published ISO/TS 21356-1 'Structural characterisation of graphene from powders and liquid dispersions' details protocols to characterise the lateral size and thickness of graphene and few-layer graphene flakes. However, these sections remain informative, until the typical variation in values obtained by different users/equipment can be validated through a VAMAS study.

Issues addressed by this standard include structural determination on the number of layers present, their thickness, homogeneity and flake size distribution between the batches. These are all issues at the nanoscale, especially thickness where a combination of measurement method, metrology and correlative imaging is needed.

CALL FOR PARTICIPATION



Example SEM image focused on an individual flake. The yellow lines drawn on the flake indicate the lateral size measurements.



High resolution topographic AFM image of an individual flake.

Work Programme

GNPs deposited onto different Si/SiO₂ substrates will be provided for each participant for SEM and AFM measurements.

Participants will be asked to measure these samples along with calibration check samples and report the lateral flake size and thickness observed.

Duration

One year beginning June 2022.

Deliverables and Dissemination

Report will evaluate the variance observed of the associated measurement protocol, to guide further development. Results will be published in a peer-reviewed journal and will be directly used in ISO/IEC standards.

Funding

Participants in the interlaboratory comparison will fund their own involvement (approx. 4 days' work).

International Participation

Current participants represent the UK, EU, China and the USA. Wider regional participation would be greatly welcomed.

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