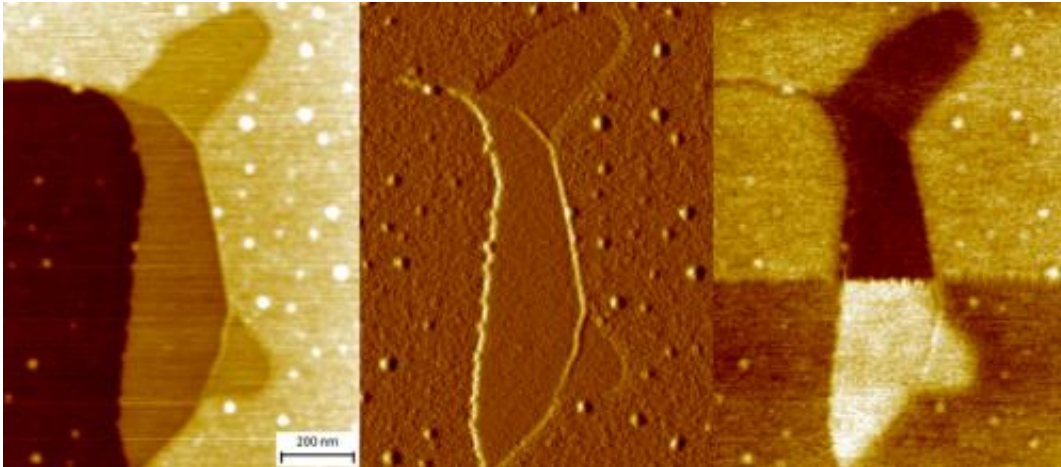


Seeing an atomic thickness

May 19 2011



The left hand image is the topography; the middle the topography error image; and right the electrostatic force microscopy image where the tip bias has been switched half way through the image.

Scientists from NPL, in collaboration with Linköping University, Sweden, have shown that regions of graphene of different thickness can be easily identified in ambient conditions using Electrostatic Force Microscopy (EFM).

The exciting properties of graphene are usually only applicable to the material that consists of one or two layers of the graphene sheets. Whilst [synthesis](#) of any number of layers is possible, the thicker layers have properties closer to the more common bulk [graphite](#).

For device applications one- and two-layer graphene needs to be

precisely identified apart from the [substrate](#) and regions of thicker graphene. Exfoliated graphene sheets up to $\sim 100\text{ }\mu\text{m}$ in size can be routinely identified by optical microscopy. However, the situation is much more complicated in the case of the epitaxial graphene grown on silicon carbide wafers with a diameter up to 5 inches where the straightforward identification of the graphene thickness is difficult using standard techniques. This research shows that EFM, which is one of the most widely accessible and simplest implementations of scanning probe microscopy, can clearly identify different [graphene](#) thicknesses. The technique can also be used in ambient environments applicable to industrial requirements.

This work was recently published in [Nano Letters](#).

More information: Mapping of Local Electrical Properties in Epitaxial Graphene Using Electrostatic Force Microscopy, Nano Lett., Article ASAP [DOI: 10.1021/nl200581g](https://doi.org/10.1021/nl200581g)

Abstract

Local electrical characterization of epitaxial graphene grown on 4H-SiC(0001) using electrostatic force microscopy (EFM) in ambient conditions and at elevated temperatures is presented. EFM provides a straightforward identification of graphene with different numbers of layers on the substrate where topographical determination is hindered by adsorbates. Novel EFM spectroscopy has been developed measuring the EFM phase as a function of the electrical DC bias, establishing a rigorous way to distinguish graphene domains and facilitating optimization of EFM imaging.

Provided by NPL

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