LOCAL ELECTRICAL PROPERTY MAPPING IN EPITAXIAL GRAPHENE USING ELECTROSTATIC FORCE MICROSCOPY

T. Burnett[a], **R. Yakimova**[b] and **O. Kazakova**[a]

[a]National Physical Laboratory, Teddington, TW11 0LW, UK
[b]Linkoping University, Linkoping, SE-581 83, Sweden

In this work we perform local electrical characterization of epitaxial graphene grown on 4H-SiC(0001) using electrostatic force microscopy and scanning kelvin force microscopy in ambient conditions and at elevated temperatures. The presented microscopy results allow a simple and straightforward identification of different layer thicknesses of graphene as well as distinction from carbon-rich interfacial layers. We have developed a spectroscopy method that allows the different layers of graphene to be identified using EFM phase as a function of the electrical DC bias applied either to the probe or to the graphene sample. This spectroscopy method also allows for a choice of the EFM conditions to optimise the contrast between different regions of the sample. We also show that measurements of the step heights are extremely unreliable in identifying the layer thickness of graphene in ambient conditions. Scanning kelvin probe force microscopy has also been demonstrated to clearly identify single layer graphene but in ambient conditions the ability to distinguish other graphene layer thicknesses is very limited. EFM imaging combined with the optimisation of the contrast using the spectroscopy has the ability to identify between multiple layers of graphene at least up to 3LG. This really promotes EFM as a very attractive way of imaging and identifying graphene and is applicable in ambient conditions. The ease with which this technique can identify graphene we believe will be invaluable for researchers wishing to easily distinguish between graphene domains and will also allow regions appropriate for devices to be recognised.