2D materials: graphene and beyond

The Quantum Detection team at NPL focuses on world-leading fundamental research that exploits quantum phenomena and explores new areas of measurement science that could revolutionise modern metrology. Graphene research in the Quantum Detection team focuses on structural and functional engineering, physics and metrology of graphene and graphene-based heterostructures. In particular, we are carrying out a series of projects dedicated to researching metrology for the characterisation of graphene and other 2-D materials and helping develop standardisation, which will be important to future applications and mass production.

Owing to its impressive properties, graphene, a single layer of graphite one atom thick, is expected to have a significant impact on a large variety of real-life applications, such as high-frequency transistors, chemical and biological sensors, solar cells, to mention just a few. The methods already known for isolation of graphene can be extended to a whole new family of graphene-like materials, the two-dimensional (2D) atomic crystals, opening up new horizons for applications beyond the capability of graphene. To be able to realise the potential of graphene and 2D materials in terms of practical applications, their electrical properties need to be known, together with the response to external and environmental factors, such as temperature and humidity.

The student will work within the frame of an on-going project at NPL to investigate the electronic properties of graphene and 2D materials (such as MoS$_2$, Bi$_2$Se$_3$, GaSe, etc) using scanning probe microscopy and Raman spectroscopy. The effect of water adsorption and change in temperature on the electronic properties of graphene oxide will also be investigated using scanning Kelvin probe microscopy.

The student will fabricate single layer 2D materials using mechanical exfoliation and will perform morphological and electrical characterization of these using scanning probe microscopy techniques. The project will benefit from a student who enjoys experimental work, training will be provided, however familiarity with the properties of graphene and graphene-like materials, although not compulsory, will be of help.