ABSTRACT

Two dimensional materials are investigated with a variety of spectroscopic methods including metastable (helium) induced electron spectroscopy, ultraviolet photoelectron spectroscopy, x-ray photoelectron spectroscopy, Raman spectroscopy and Auger electron spectroscopy complimented with scanning electron microscopy. Characterising the surfaces of materials that form interfaces within a device is imperative for the development or fabrication of devices with optimal performances.

Materials such as graphene oxide, graphene and carbon nanotubes owe their electronic properties to their sp^2 networks. Graphene oxide prepared with various annealing temperatures has been characterised with ultraviolet photoelectron spectroscopy and x-ray photoelectron spectroscopy, determining the electronic structure and the composition of the surface for the temperature series. It has been determined that higher annealing temperatures resulted in improved sp^2 concentrations and hence improved charge transport properties.

The thickness of two dimensional materials is often less than the probing depth of spectroscopic methods. Graphene is characterised using metastable (helium) induced electron spectroscopy, x-ray photoelectron spectroscopy and Raman spectroscopy to exclusively determine the electronic structure of the graphene layers. It was determined that the number of layers and defects greatly influences its electronic structure.

A concept is developed to measure the inner coaxial tube within double wall carbon nanotubes utilising the difference in surface sensitivity of ultraviolet photoelectron spectroscopy and metastable (helium) electron spectroscopy. Defects in the outer walls are shown to lower the charge transport properties whilst the inner walls retain their sp^2 network and optimal charge transport properties.

MoS_2 films are characterised using ultraviolet photoelectron spectroscopy, Raman spectroscopy, Auger electron spectroscopy and scanning electron microscopy. The electronic structure of non-homogenous few layer MoS_2 is quantitatively determined and compared with bulk MoS_2.