Probing the nano world – an overview of Raman spectroscopy and its key role in ACN research

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Carbon Nanomaterials are attracting intense scientific interest because of their extraordinary electronic, thermal and mechanical properties. Raman Spectroscopy has been found to be extremely useful in many areas of research of these materials, both because of its specificity, its no-destructive nature, limited sample preparation requirements and ease of use. Raman can easily distinguish between Carbon and other materials and the many different allotropes of Carbon from Diamond like carbon (DLC) to Fullerenes to Carbon Nanotubes, Graphite and Graphene. We will present and overview of Raman spectroscopy and its wide range of applications in the field of ACNs.

It has been widely shown that the electrical behaviour of SWNTs is influenced by their diameter and chirality. While Raman is an optical technique and therefore limited to diffraction limited resolution it is a very useful tool in CNT studies and can be used to determine many of the properties of CNTs including their diameter, chirality, electronic properties and strain in both bulk material and isolated nanotubes. Due to its non-destructive nature Raman can be used to probe morphological differences and changes.

Isolated nanotubes exhibit Raman resonance effect that can be used to determine the diameter of the tubes. By measuring the Raman frequency of the Radial Breathing Modes (RBMs) the diameter can be determined [1]. Measurement of the position of other peaks in the spectra, such as D, G and G' bands provides information about the internal disorder, electrical properties and electronic structural information respectively.

An exciting recent development has been the combination of Raman and AFM. This is now opening up new areas of research and providing additional tools to probe the Nano World.

[1] Raman spectroscopy of carbon nanotubes M.S. Dresselhaus, G. Dresselhaus, R. Saito, A. Jorio 10.1016/j.physrep.2004.10.0006