Optical characterization of graphene using spectroscopic ellipsometry and raman micro-spectrometry

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The Nobel Prize in Physics in 2010 was awarded to Professors Andrew Geim and Konstantin Novoselov for their isolation and characterization of graphene. Graphene is a bidimensional carbon crystal and the basic structural element of some carbon allotropes including graphite, carbon nanotubes and fullerenes, first reported in Science in 2004. It is the thinnest, yet strongest, material known, being both brittle and ductile simultaneously. Thus, it exhibits excellent transport properties which make it a promising material for future nanoelectronic devices, namely for high-electron-mobility transistors (HMET). Other applications are also considered such as paper-thin computer monitors, transparent touch screen, light panel or solar cells.

Due to its size and optical properties, graphene is hardly visible on most substrates. However, distinguishing the number of graphene layers as well as quantifying the impact of disorder on its properties is critical for the study of graphene-based devices.

Among the panel of techniques available, Spectroscopic Ellipsometry and Raman Micro-Spectroscopy come out due to their ease of use and the complementary information they provide. The presentation will illustrate on some examples the capabilities of the two techniques.

Raman micro-spectroscopy has proven to be a convenient and reliable technique for determining graphene properties. Indeed, this technique is non invasive and non destructive and it offers both chemical and structural information. With its high spatial resolution (below the micron), Raman imaging is very useful to localise very quickly the different graphene layers and detect some edge effects.

Spectroscopic Ellipsometry is a very powerful optical technique used to measure thin film thickness from 1 Å to tens of microns, optical constants, bandgap energy, surface and interface roughness, etc. It can be applied in situ or ex situ and it is ideally suited for the control of graphene thin film.