Wafer-Scale Growth and Characterisation of Graphene and hBN/Graphene Heterostructures on Sapphire

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Graphene, a two-dimensional (2D) form of carbon, ever since its first isolation has attracted an increasing interest both from academia and industry. Rapid research developments in the past decade have also spurred synthesis and research of other 2D materials (such as hexagonal boron nitride, hBN), which cover a wide range of different electronic, magnetic and optical properties. Despite demonstrated outstanding intrinsic properties of graphene, such as high charge carrier mobility, translating laboratory results to large scale microelectronics and optoelectronics applications has proved to be difficult. In particular, growth on catalytic metal substrates requires subsequent graphene film transfer onto dielectric substrate for microelectronic applications, which results in transfer related defects as well as high metal contamination level. More generally, there is ongoing effort both in academia and industry to develop deposition and characterization techniques of 2D materials which are high throughput, reproducible and scalable to large area wafers.
Herein, we present results of wafer scale growth and characterisation of graphene and graphene/hBN heterostructures on sapphire substrate. Both graphene and hBN synthesis is achieved in an industrial CVD reactor reaching substrate temperatures up to 1400 °C and accommodating wafers up to 200 mm in diameter. Such setting allows highly uniform deposition across the wafer exemplified by Raman and near-field THz spectroscopy of graphene film (Figure 1). Successful development of graphene on wafer-scale growth on dielectric substrates is a promising route towards fab-compatible graphene integration into microelectronic devices.

Figures

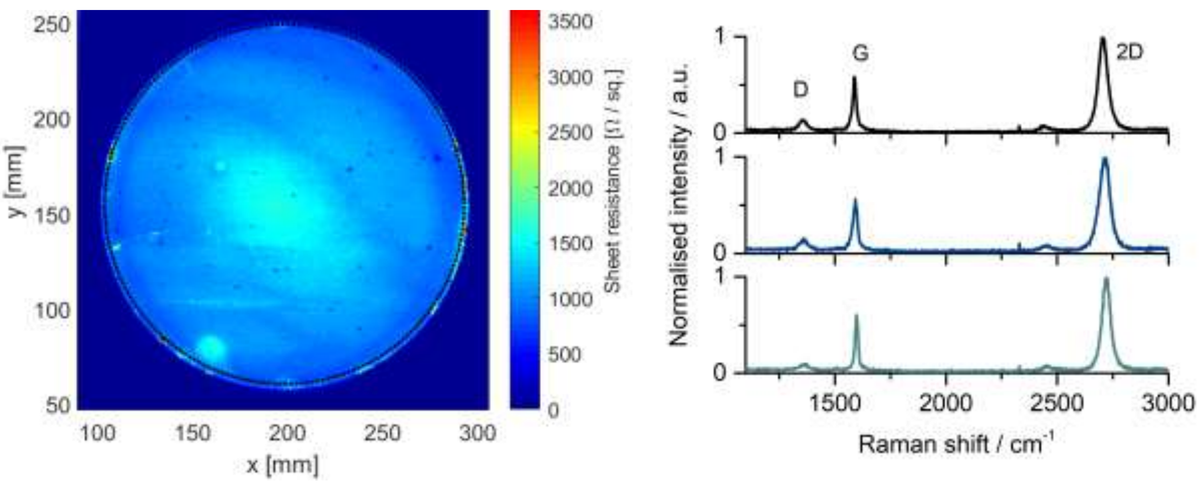

Figure 1: Sheet resistance mapping of 200 mm graphene/sapphire wafer characterised by THz spectroscopy (left); corresponding Raman spectra at different locations across 200 mm wafer (right).