Electronic Supporting Information

Graphene TEM

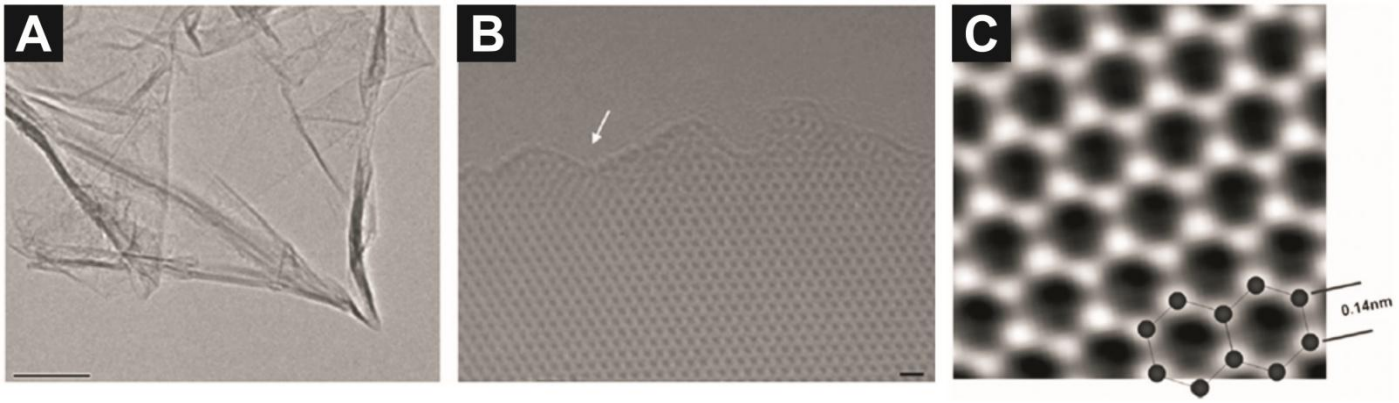
Figure S1A depicts a typical TEM image of the commercially purchased graphene and Figure S1B shows a high-resolution TEM image where a hexagonal arrangement of carbon atoms, which is characteristic of graphene, is clearly evident. Additionally, this material has been characterised and reported previously by Dato and co-workers,[1S] and Figure S1C from their work shows an atomic-resolution image that reveals a highly ordered synthesized single-layer graphene sheet – captured with an aberration-corrected transmission electron microscope (TEAM 0.5),[1] capable of clearly resolving individual carbon atoms, adsorbates, and defects on graphene at an accelerating voltage of 80 kV.[1] Fourier Transform infrared spectroscopy (FT-IR) analysis was used to determine the presence of functional groups on the graphene, where it is evident that such groups were either absent or minimal.[1] X-ray photoelectron spectroscopy (XPS) analysis was performed (using a PHI 5400 ESCA/XPS utilising an Al Ka radiation source – the spot size used was 1.1 mm in diameter) and reported to reveal that oxygen from the ethanol utilised during the synthesis process does not bond to the graphene sheets, and it was additionally reported that the clean and highly ordered free-standing graphene sheets are free from functional groups.[1]

XPS – graphene characterisation

We independently acquired XPS chemical analysis of the 'as received' graphene (performed with a VG-Microtech Multilab electron spectrometer) which reveals the material to comprise of 95.04 % atomic carbon and 4.96 % atomic oxygen. Analysis of the XPS spectra reveals a large peak at 284.6 eV associated to C-H bonding and analysis of the oxygen peak at 531.64 eV is associated to C=O functional groups. This is a very low O/C ratio, as expected for near true graphene.

Figure S1:

A: A low-magnification TEM image of the graphene sheets; the scale bar is 100 nm. **B:** A high-resolution TEM image, where the white arrow indicates the edge of the graphene sheet; the scale bar is 4 Å. **C:** An atomic-resolution image (TEAM 0.5) of a clean and structurally perfect synthesised graphene sheet. Individual carbon atoms appear white in the image. The image was obtained through the reconstruction of the electron exit wave function from 15 lattice images using MacTempas software. Reproduced with permission from Ref: [1].



1. A. Dato, V. Radmilovic, Z. Lee, J. Phillips, M. Frenklach, *Nano Lett.*, 2008, **8**, 2012.