Electronic Supplementary Information (ESI)

Exploring the origins of the apparent "electrocatalytic" oxidation of kojic acid at graphene modified electrodes

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Experimental details – graphene synthesis

Pristine graphene is commercially obtained from 'Graphene Supermarket' (Reading, MA, USA) [1] and is produced *via* a substrate-free gas-phase synthesis method. [2-4] This single-step technique involves sending an aerosol consisting of liquid ethanol droplets and argon gas directly into a microwave-generated argon plasma (at atmospheric-pressure), where over a time scale in the order of 10^{-1} s, ethanol droplets evaporate and dissociate in the plasma forming solid matter that through characterisation by Transmission Electron Microscopy (TEM) and

Raman spectroscopy is confirmed to be true graphene. [2, 3] The fabricated graphene sheets are sonicated in ethanol to form a homogeneous suspension before being distributed. [1, 4]

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 by Dato and co-workers, [3] 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), [3] capable of clearly resolving individual carbon atoms, adsorbates, and defects on graphene at an accelerating voltage of 80 kV. [3] 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. [3] 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. [3]

Figure S1

(A) A typical 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: [3].

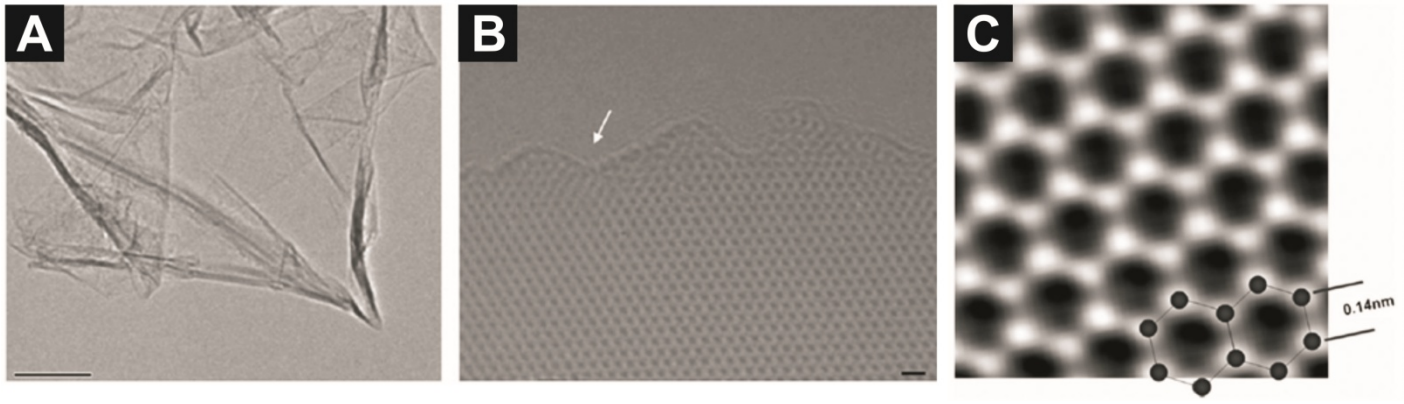
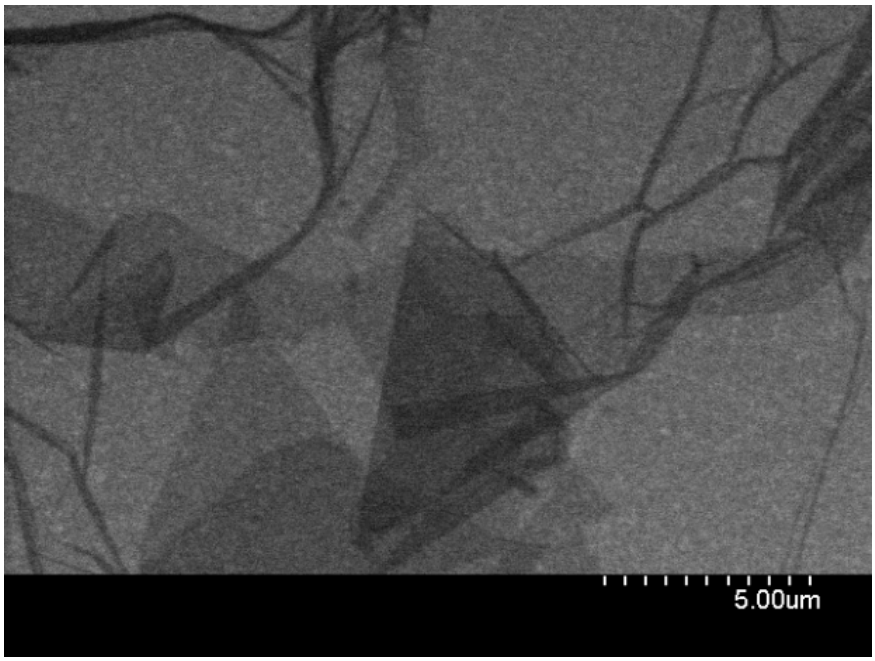


Figure S2

A typical SEM image of the commercially available graphene oxide, as provided by the manufacturer, Ref: [1].



References

1. www.graphene-supermarket.com.
2. A. Dato, V. Radmilovic, Z. Lee, J. Phillips and M. Frenklach, *Nano Lett.*, 2008, **8**, 2012.
3. A. Dato, Z. Lee, K-J. Jeon, R. Erni, V. Radmilovic, T. J. Richardson and M. Frenklach, *Chem. Commun.*, 2009, 6095.
4. Z. Lee, K-J. Jeon, A. Dato, R. Erni, T. J. Richardson, M. Frenklach and V. Radmilovic, *Nano Lett.*, 2009, **9**, 3365.