Electronic Supporting Information (ESI)

CVD-Graphene Substrate – Housing

As illustrated in ESI Figure 1A, a CVD graphene chip housing was utilised which has been adapted from reference [1] comprising of four parts; the PTFE lid, a PTFE shell, an electrode connector, and the CVD graphene chip itself. [1] The CVD graphene chip was secured into the PTFE housing unit with a silicone O-ring, concealed in the top of the lid and positioned central to the CVD chip surface, defining the working surface (diameter, 3.9 mm) – as the lid is fastened onto the shell the spring and steel contact tenderly push the CVD chip up against the O-ring to establish a tight seal without incurring damage to the electrode's working surface. [1] The steel contact establishes an electrical connection to the back of the CVD chip, which *via* the use of silver conductive paint (applied to cover the back and sides of the chip in their entirety – that are otherwise not electrically conductive) ensures electrical conductivity from the front 'working surface' of the electrode, and because the electrode connector is made entirely of steel an electrical contact is thus established between the working surface of the electrode and the bottom of the connector, to which a lead for the working electrode can be attached. [1] ESI Figure 1B depicts a cross-sectional view of the assembled housing unit.

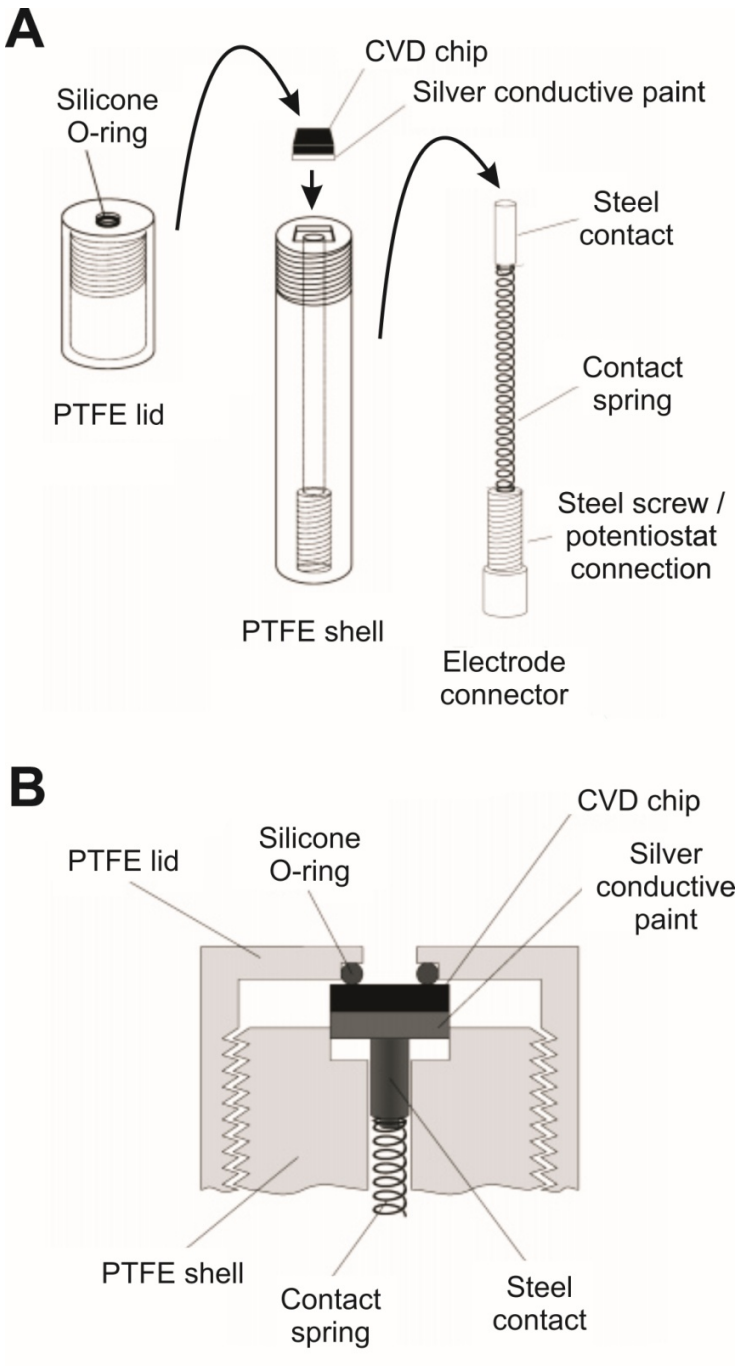
CVD-Graphene Substrate – XPS Analysis

We acquired XPS chemical analysis (performed with a K-Alpha Thermo Fisher X-ray fotoelectron spectrometer) of the 'as received' CVD-graphene, which due to its fabrication is deposited upon a nickel (Ni) substrate, which reveals the materials composition to comprise distinctly of carbon. XPS spectrum of the CVD-graphene revealed 63.2 % C1s at 284.6 eV which corresponds to C-H, C-C, $(CH_2)_n$ and C=C bonds that are characteristic of graphite/graphene, additionally 18.54 % of C1s occurred at 285.2 eV which is characteristic of C-C bonds: total carbon content at the CVD-graphene was 81.74 %. De-convolution of the XPS spectrum of O1s revealed oxygen content on the CVD-graphene of 5.97 %, 3.57 % of which originated from the contamination of graphite (532.2 eV), that implies the CVD-graphene has a pure carbon layer with low oxygen content (few oxygen impurities). Note, 1.95 % (532.8 eV)

and 0.45% (533.7eV) of the sample corresponded to C=O, C-OH and C-O-C, and O from H_2O adsorption. Furthermore, XPS revealed the presence of 8.81 % atomic Ni and 3.47 % atomic Si which are resultant from the relative probe depth of the XPS and thus originate from the underlying substrate. Superior insights can be observed with Raman (see main text).

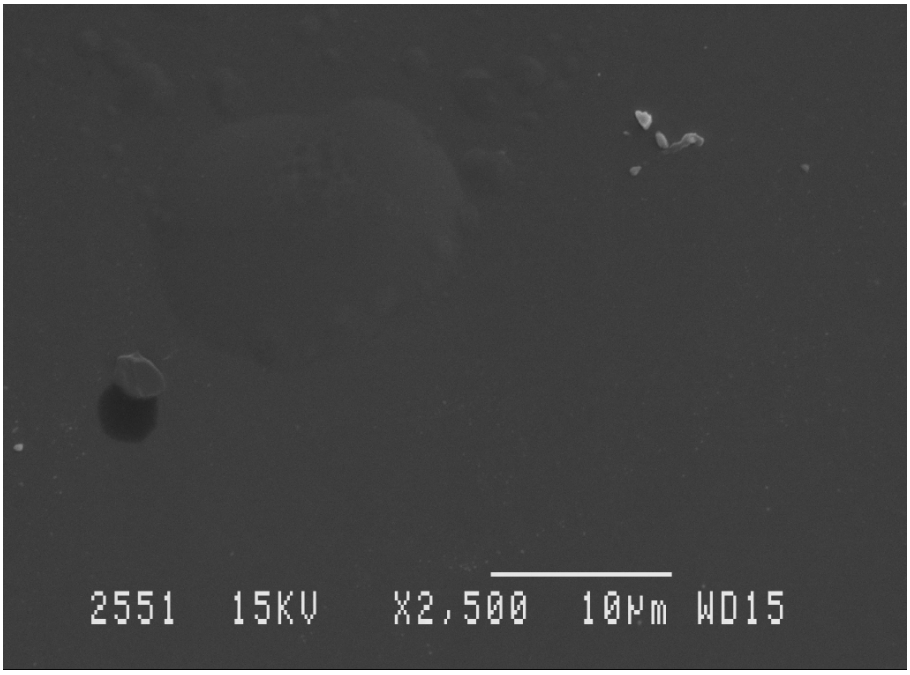
ESI Figure 1

A) Schematic diagram of the four-part CVD-graphene substrate 'housing' unit. **B)** Cross-sectional view of the assembled CVD-graphene substrate working electrode when fully 'housed'. Adapted from reference [1] for exclusive use with CVD-graphene chips/substrates.



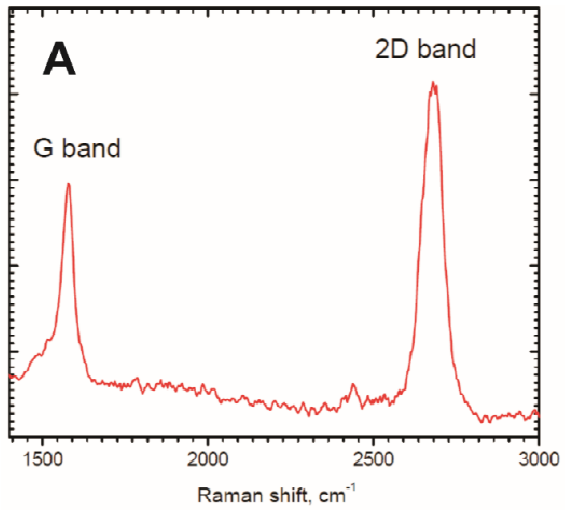
ESI Figure 2

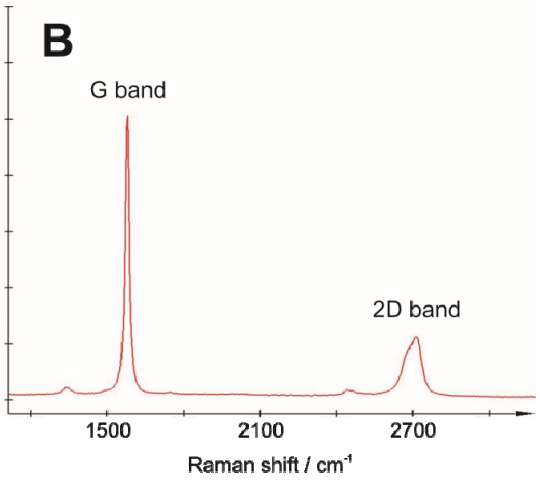
SEM image of the bare (no graphene) Ni film on an oxidised silicon wafer.



ESI Figure 3

Raman spectra of our commercially obtained CVD-graphene grown directly onto a Ni film on an oxidised silicon wafer, showing both graphene **(A)** and graphitic **(B)** regions. Images kindly provided by the manufacturer. [2]





References:

ESI1. R. Bowler, T. J. Davies, M. E. Hyde and R. G. Compton, *Anal. Chem.*, 2005, **77**, 1916.
ESI2. www.graphene-supermarket.com: Raman is part of characterisation of a batch of CVD graphene chips.