

# Substrate Dependent Photochemical Oxidation of Monolayer Graphene

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## Supporting Information

### **Synthesis of Graphene**

Copper foil (Alfa Aesar, 0.025 mm thickness) was cut into strips of dimensions ~5 cm x 2 cm and these strips were cleaned by briefly placing them in concentrated HCl (Fisher Scientific) followed by two DI water baths and subsequent drying under a nitrogen stream. The copper foil was placed in a quartz tube furnace that was evacuated and filled with hydrogen flowing at 2 SCCM for a total pressure of approximately 80 mTorr. The tube furnace temperature was raised to 1000 °C and the copper foil was annealed for 30 minutes at 1000 °C. Methane was subsequently added into the tube furnace at a flow rate of 20 SCCM resulting in a total pressure of 500 mTorr. After thirty minutes of methane flow, the tube

furnace was allowed to cool with hydrogen and methane flowing. Upon cooling, graphene covered copper foil (CuCVD-G) was retrieved from the tube furnace<sup>S1</sup>.

### **Transferring of Graphene onto Various Substrates**

The CuCVD-G samples were spin-coated with a poly-methyl methacrylate (PMMA) (Sigma-Aldrich) solution (50 mg/mL in anisole). The underlying copper of the PMMA-coated samples was subsequently etched by floating the samples in a solution of 1M FeCl<sub>3</sub> (Sigma-Aldrich) in 10% HCl (Fisher Scientific). The floating PMMA-graphene films were moved into a water bath by using a glass slide and lastly transferred onto the desired substrate. Prior to the transfer, the silicon and mica target substrates were cleaned by rinsing with deionized water and acetone, followed by another deionized water wash and subsequent drying under a nitrogen stream. After the graphene had been transferred onto the desired substrates, the samples were allowed to dry and subsequently placed in acetone for 24 hours to dissolve the PMMA, yielding graphene on the target substrate<sup>S2</sup>.

### **Characterization of Graphene on Samples**

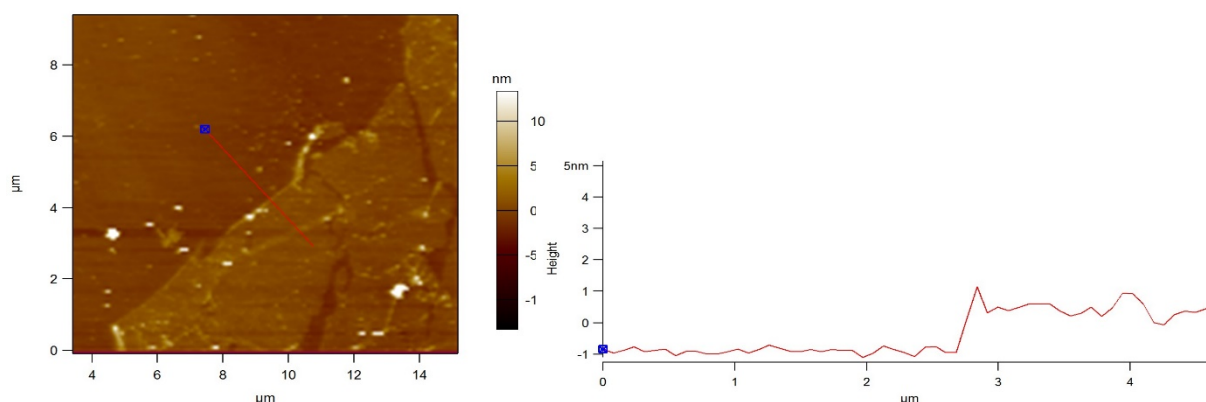
All Raman measurements were obtained using a home-built Raman microscopy setup with a solid state laser with excitation wavelength of 532 nm and spot size of less than 1  $\mu$ m. The laser irradiated the samples with a power of less than 1 mW to ensure that damage did not occur during measurements. Signal integration times of 30 seconds were used for graphene samples on silicon wafer with thermal oxide and mica, and three accumulations with signal integration times of 10 minutes per accumulation were used for graphene samples on silicon wafer with native oxide. All measurements of graphene on silicon wafer with thermal oxide and mica were obtained using identical conditions. X-Ray photoelectron spectroscopy (XPS) measurements

were obtained with a Thermo Scientific™ ESCALAB 250Xi. X-Ray source was monochromatic and used an Al anode. Spot size was 0.9 mm with an angle of 45°. In order to ensure precise measurements, a minimal of 10 scans were employed for good resolution. Spectra were acquired, deconvoluted, and analyzed using Thermo Scientific™ Advantage Data System software. Peak fitting allowed for Lorentzian-Gaussian ratio control as well as difference spectra optimization, with the Smart method being implemented to calculate the background. Atomic force microscopy (AFM) images were obtained using an Asylum MFP-3D AFM in AC Air mode with an 8 nm radius silicon tip (MikroMasch). Optical microscopy was conducted on a Nikon Eclipse TI-U in reflectance using an Ample Scientific 3.0 MP camera.

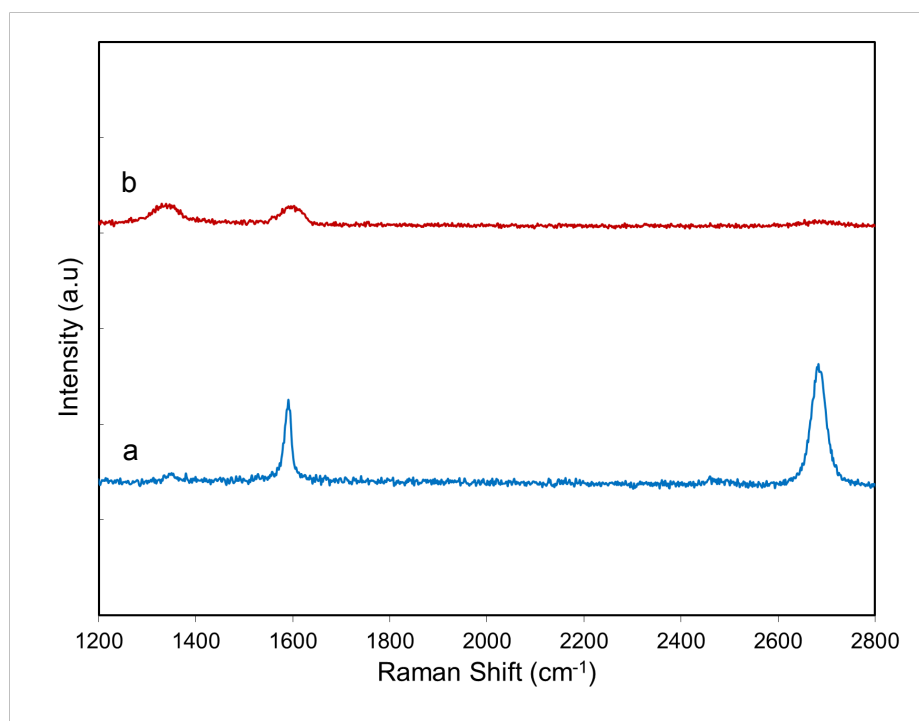
### UV-Ozone Treatment of Samples

Samples were placed in a Novascan PSD-UV digital UV-Ozone system and oxygen gas was allowed to fill the closed chamber for approximately one minute. The oxygen was subsequently shut off and the samples were irradiated with ultraviolet light. After 30 minutes of irradiation the chamber was purged with nitrogen gas and the samples were removed.

**Figure S1.** AFM image of CVD graphene transferred onto silicon wafer and height trace across the edge of the graphene film.



**Figure S2.** Raman spectra of graphene that was transferred onto mica and subsequently treated with UVO. (a) Raman spectrum of graphene on mica prior to UVO treatment. (b) Raman spectrum of graphene on mica after UVO treatment. Integration times of 30 seconds were used in both spectra.



## References

- S1. Li, X.; Cai, W.; An, J.; Kim, S.; Nah, J.; Yang, D.; Piner, R.; Velamakanni, A.; Jung, I.; Tutuc, E.; Banerjee, S. K.; Colombo, L.; Ruoff, R. S., Large-Area Synthesis of High-Quality and Uniform Graphene Films on Copper Foils. *Science* **2009**, *324* (5932), 1312-1314.
- S2. Li, X.; Zhu, Y.; Cai, W.; Borysiak, M.; Han, B.; Chen, D.; Piner, R. D.; Colombo, L.; Ruoff, R. S., Transfer of Large-Area Graphene Films for High-Performance Transparent Conductive Electrodes. *Nano Letters* **2009**, *9* (12), 4359-4363.

