

PRODUCT TEST REPORT

Graphene Oxide Paste

Equipment used

RAMAN : BRUKER SENTERRA II -Confocal Raman Microscope
AFM : Park Systems XE 100 Atomic Force Microscope
XPS : Thermo Scientific™ ESCALAB™ Xi+ X-ray Photoelectron Spectrometer
XRD : BRUKER D8 Focus X-ray diffractometer
FTIR : BRUKER Vertex80 FTIR microscope (Hyperion)

Sample Details

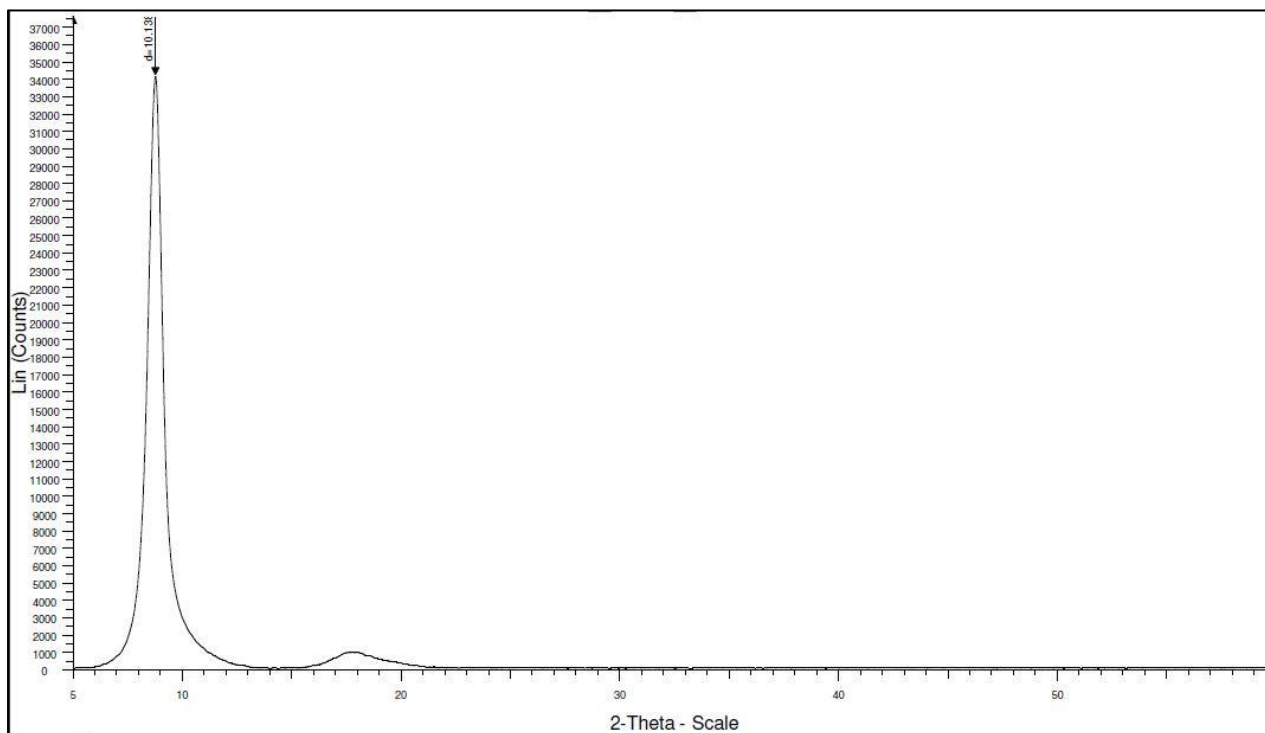
Start-up Graphite : C99+ Vein Graphite, Particle size range: 63-90 µm

Product	GO Paste
Color	Brown
Odor	Odorless
Initial Moisture Content (%)	85 - 95
GO Content (g/kg)	150 - 50
pH range (at 25 °C)	2 - 3

Analysis

X-ray powder diffraction (XRD)

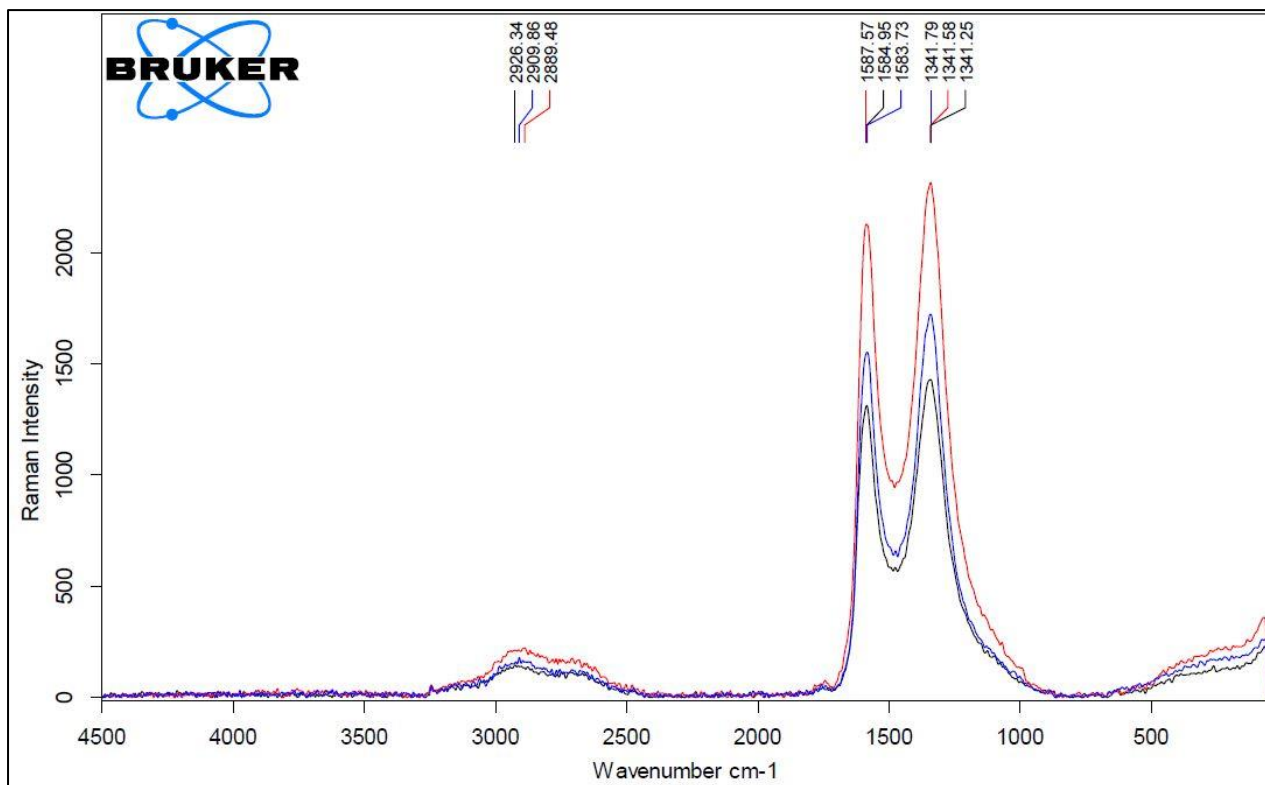
The sample was mounted on sample holder. Parameters were set as follows, Cu K α radiation ($\lambda=0.154$ nm) over a 2θ range of 5–60° with a step size of 0.02° and a step time of 10 s.



d-spacing 9 - 10 Å

RAMAN Analysis

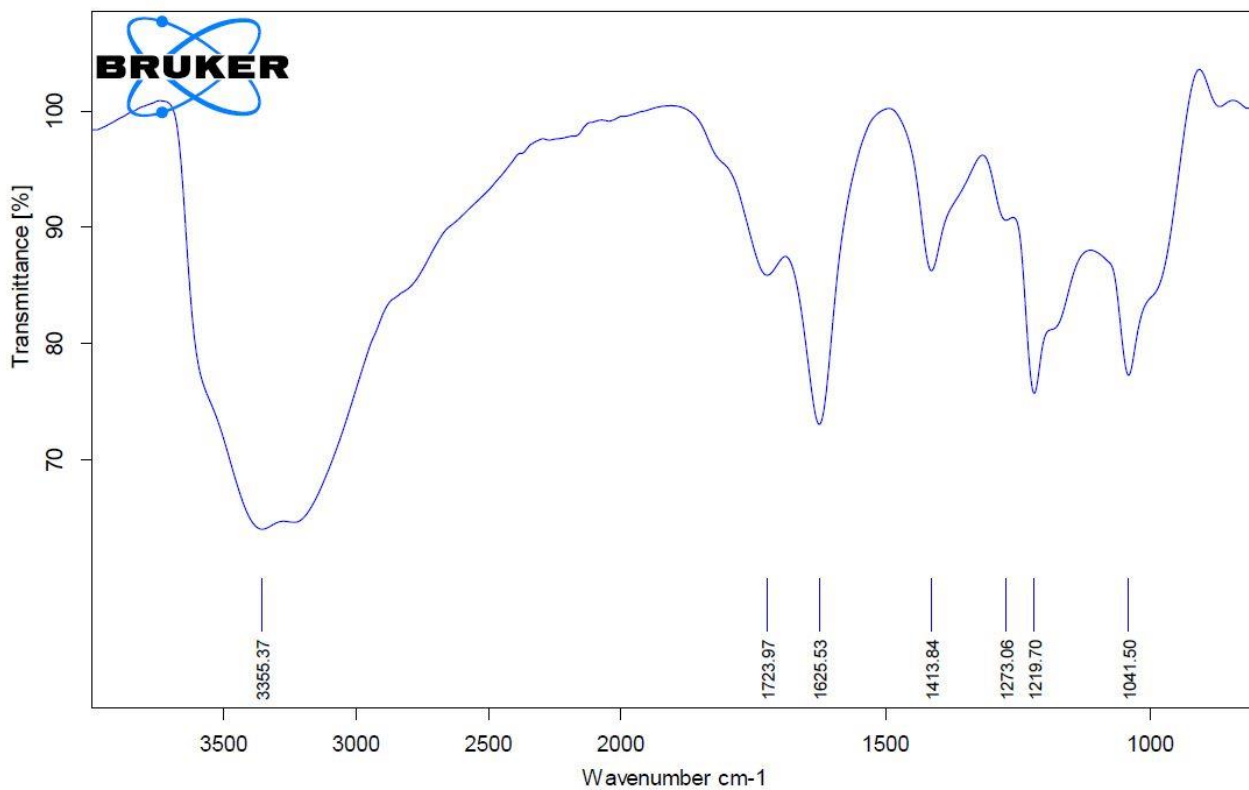
The sample was drop casted on SiO₂ wafers whose oxide thickness is 300 nm. Three different spots were analyzed. Parameters were set as follows, 532 nm; green laser was used with 20X optical zooming.



Average I_d/I_g ratio: 1.01 – 1.10

Fourier-transform infrared spectroscopy (FTIR)

Attenuated total reflection Fourier transform infrared (ATR-FTIR) spectra of the graphene oxide were recorded in the region 800 to 4000 cm^{-1} at a resolution of 4 cm^{-1} .

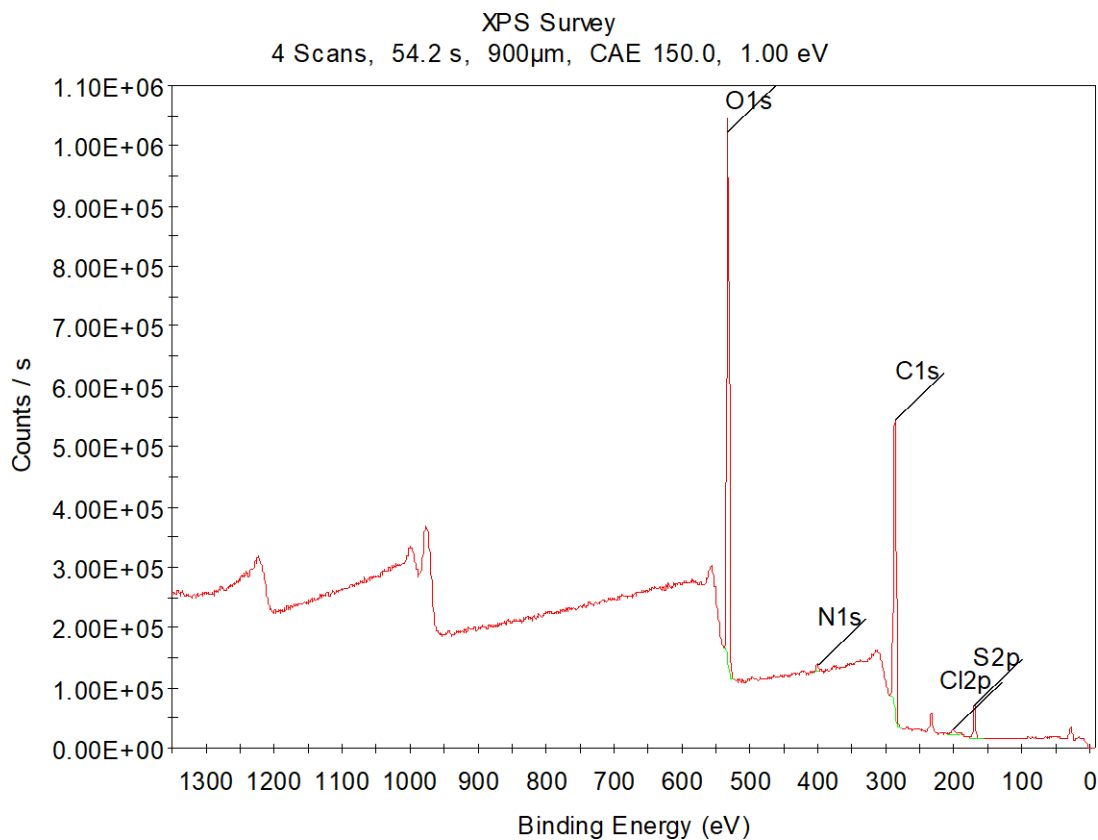


X-ray Photoelectron Spectroscopy (XPS)

The sample was mounted on a glass substrate using double tape. Three different spots per sample were analyzed. Parameters were set as follows, X-Ray source: Monochromatic Al K α (1486.6 eV), Spot size: 900 μ m. Survey scans and high-resolution scans were collected with pass energies of 150 and 20 eV and with a step size of 1.0 and 0.05 eV. Detailed spectra processing was performed by Thermo Avantage (5.982) software.

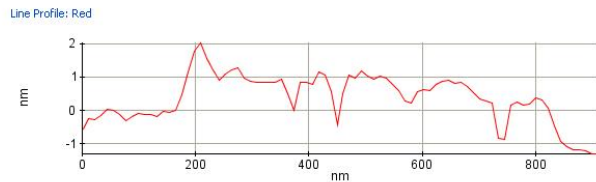
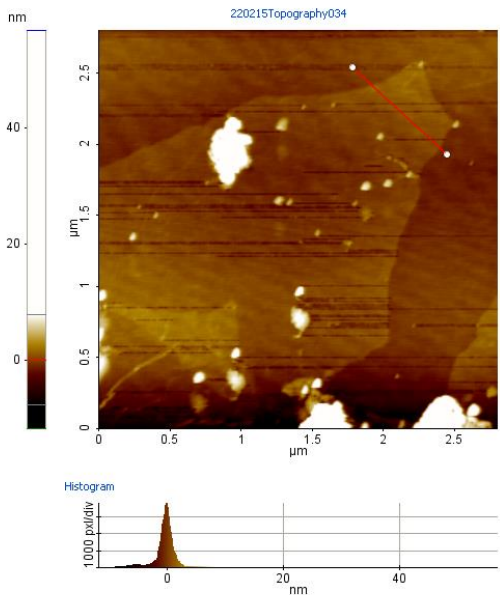
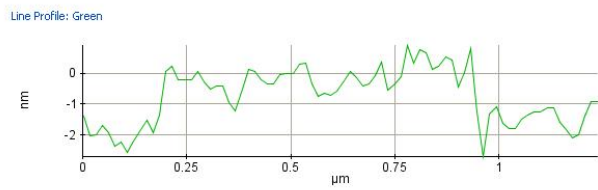
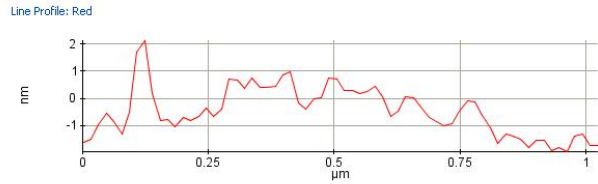
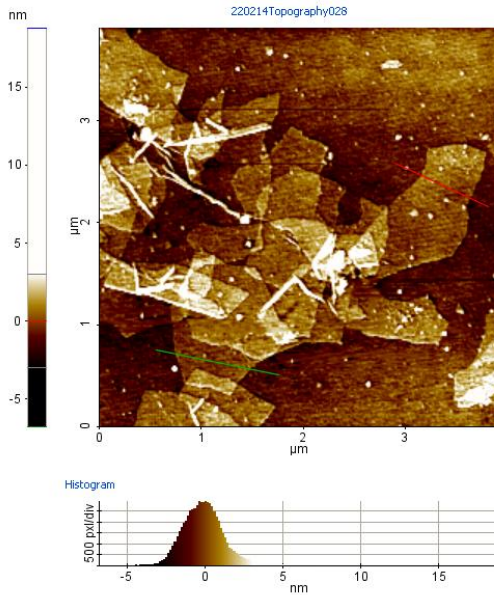
Name	Peak BE	Atomic %			Avg. %
		scan 1	scan 2	scan 3	
O1s	531.77	34.12	34.76	33.73	34.20
C1s	285.1	62.16	61.27	62.24	61.89
N1s	399.93	0.56	0.82	0.79	0.72
S2p	168.39	2.85	2.78	2.77	2.80
Cl2p	199.44	0.31	0.37	0.47	0.38

***C/O ratio: 1.80 – 2.40**



Atomic Force Microscopic (AFM) Analysis

The sample was drop casted on a 300 nm (Oxide thickness) Silicon Dioxide Wafer of dimension 1 cm x 1 cm. The concentration of the GO Dispersion prepared was 0.01 mg/ml.



Average Through Plane Dimension (Z – axis)	= ~ 2.0 nm
Average Lateral Dimension (X & Y axis)	= 1 - 2 μm