

SUPREME Graphene Oxide

Single Layer Nanosheets

The first graphene samples were obtained by peeling off a single layer of graphite using Scotch tape. While this process is simple and straightforward, it is not practical for graphene manufacture. Over the past decade, several other approaches have been developed for the preparation of graphene, such as chemical vapor deposition, epitaxial growth, liquid phase exfoliation and chemical approach through the oxidation and reduction of graphite oxide. Out of these methods, the chemical approach shows greater potential for large scale manufacturing due to the facile functionalization of graphene oxide and its excellent dispersibility in water. In fact, graphene oxide is currently being explored in many companies and research labs around the world as a precursor to graphene. In addition, graphene oxide can be used in a variety of applications from surfactants, photonics and optoelectronic devices to water filtration and protective coatings. Our process demonstrates good control over the carbon/oxygen content and exhibits a higher surface area than any of the GO products available in the market. Pimata offers monolayer graphene oxide in manufacturing quantities for mainstream commercial applications.

PRODUCT SELECTION

We offer a broad selection of graphene oxide in different physical states, concentrations and quantities. Please see our website for product selections and pricing.



CHARACTERISTICS	DATA		
Appearance	Dispersion	Paste	Powder
Color	Golden Brown	Brown	Golden Brown
Odor	Odorless	Odorless	Odorless
Solid Content (Conc/)	Customized 0.01-0.5% (w/w)	7-11.5% (w/w)	NA
Solvent	Water	Water	Dry Powder
pH of the product	3.0-5.0	1.9-3.0	NA
Apparent (tapped) density	0.9927 g/cm ³	0.90-1.05 g/cm ³	0.2- 0.45 g/cm ³
Carbon content (XPS)	70.8 % (atomic)		
Oxygen content (XPS)	27.8 % (atomic)		
Ash (XPS)	<1.4 % (atomic)		
Dispersibility	Dispersible in polar solvents including water, ethanol, isopropanol, NMP, DMF, and ethylene glycol		
Lateral size of ultrasonic dispersed GO sheets ¹	D90: 2.5 µm; D50: 0.9 µm; D10: 0.3 µm (precision ±20%)		
Particle size distribution of bulk powder ²	D90: 16.9 µm; D50: 10.7 µm; D10: 6.3 µm		
Number of layers ³	Single atomic layers ≈ 94.9%		

1. Lateral flake size measured using AFM imaging of a GO film deposited on a silicon wafer, where the GO dispersion is probe sonicated for a few minutes before coating.
2. Particle size analysis was conducted using a Horiba LA-960N laser scattering particle size analyzer.
3. Single atomic layers can be achieved by dispersing GO in water followed by sonication for at least 5 min (probe) or 30 min (bath).

APPLICATIONS

- Graphene research
- Energy conversion
- Energy storage
- Electronics
- Conductive inks and coatings
- Composites
- Catalysis
- Biomedical
- Membranes
- Sensors and biosensors
- Gas separations
- Surfactant

ELEMENTAL ANALYSIS

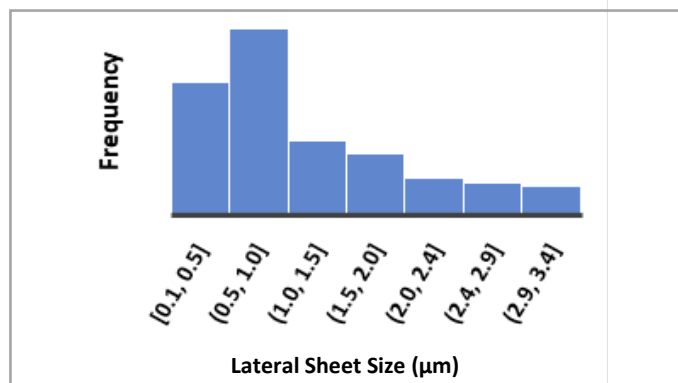
A rich oxygen content up to 51 wt% in Supreme Graphene Oxide confirms the massive attachment of oxygen-containing functional groups such as hydroxyl, epoxide, carbonyl, and carboxyl.

Carbon	40-50 wt%
Hydrogen	0-2.5 wt%
Nitrogen	<0.3 wt%
Oxygen	40-51 wt%

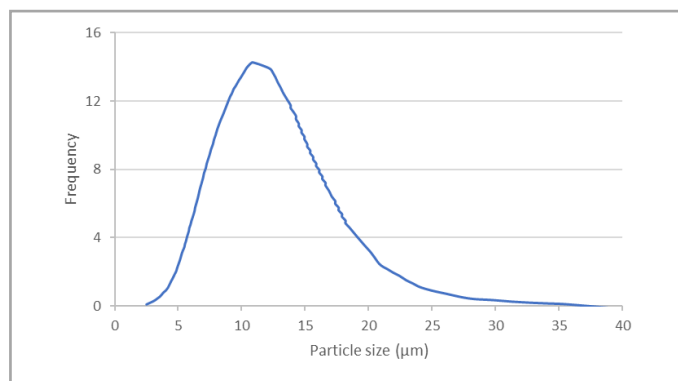
FLAKE SIZE DISTRIBUTION

Size distribution of GO: The Supreme GO flake size calculated from an AFM topography image of a GO film using ImageJ software (left), and the GO particle size measured from GO powder analyzed by a Horiba LA-960N laser scattering particle size analyzer.

flake size of Supreme GO sheets deposited on Si wafer

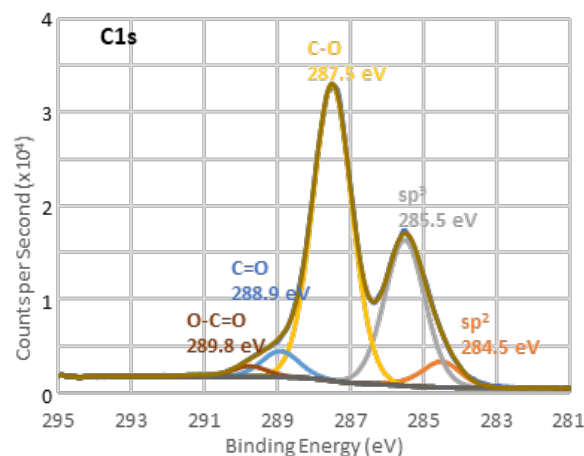
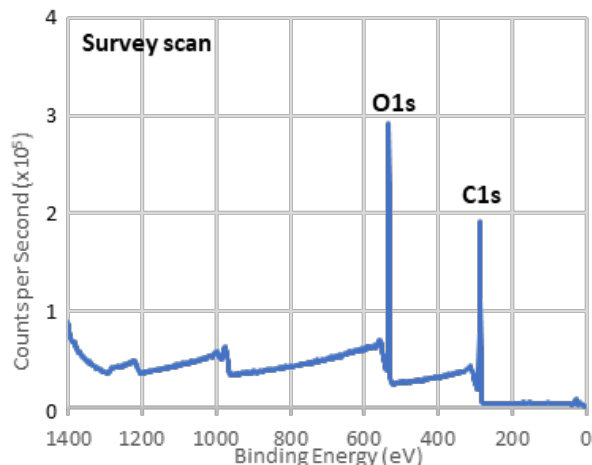


Particle size distribution of the bulk Supreme GO powder



XPS ANALYSIS

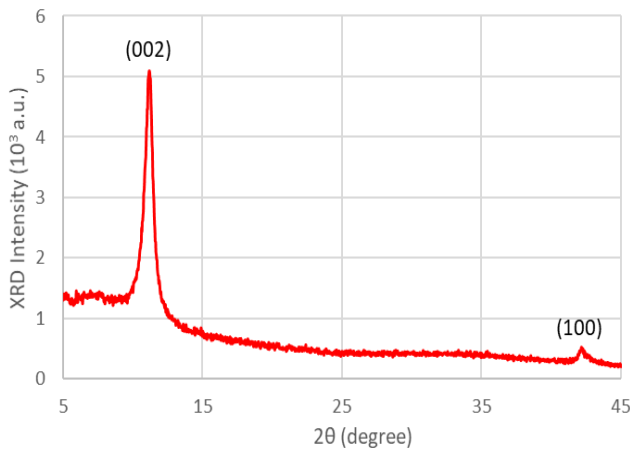
The XPS survey scan of Supreme Graphene Oxide shows the dominance of carbon (70.8 at%) and oxygen (27.8 at%) elements with no more than 1.4 at% from other elements. The high-resolution C1s spectrum of GO can be deconvoluted into five peaks corresponding to sp^2 carbon (284.5 eV), sp^3 carbon (285.5 eV), C-O (287.5 eV), C=O (288.9 eV), and O-C=O (289.8 eV). The relative intensities of the peaks provide an idea about the percentage contribution of each functional group as shown in the table.



C Species	Peak BE (eV)	Percentage (%)
sp^2	284.5	4.9
sp^3	285.5	30.2
C-O	287.5	57.1
C=O	288.9	3.2
O-C=O	289.8	3.4

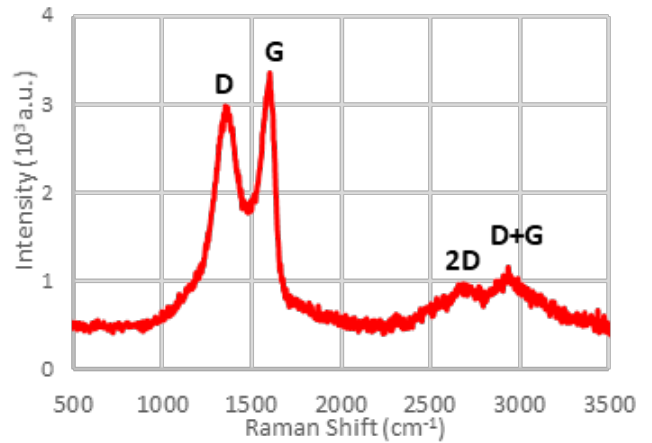
X-RAY POWDER DIFFRACTION

The 2θ peak of Supreme Graphene Oxide at 11.18° corresponds to a (002) interlayer spacing of 0.79 nm. The peak at $2\theta = 26.4^\circ$ arising from 0.34 nm graphite stacking is absent, indicating effective exfoliation.



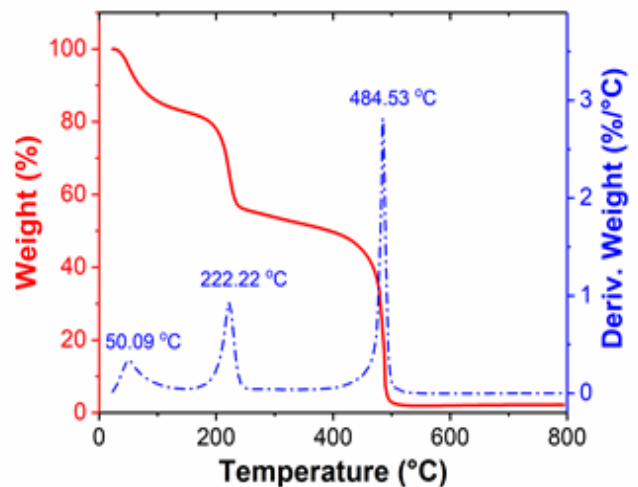
RAMAN SPECTROSCOPY

Raman spectrum of Supreme Graphene Oxide shows two intense peaks at 1350 and 1600 cm^{-1} corresponding to sp^3 and sp^2 hybridized carbons, respectively.



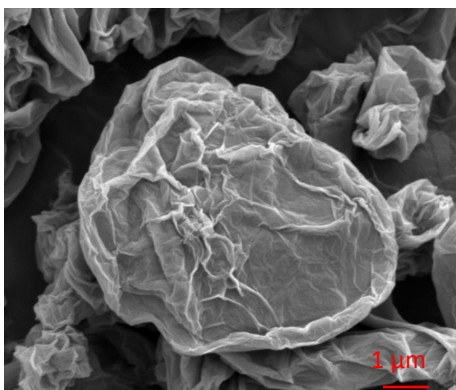
THERMAL ANALYSIS

TGA analysis of Supreme Graphene Oxide in air reveals three peaks at 50.1°C , 222.2°C , and 484.5°C corresponding to water loss, thermal reduction, and combustion, respectively.

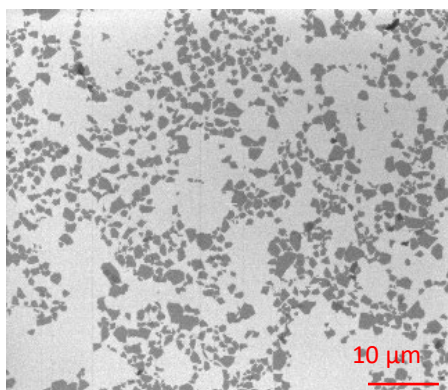


SEM IMAGING

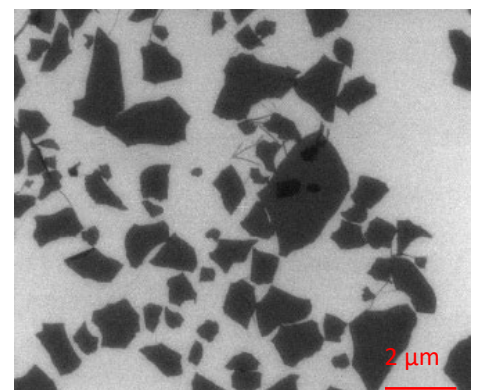
When in the dry powder form, supreme graphene oxide sheets self-assemble into cabbage like particles with a D50 of $10.7\text{ }\mu\text{m}$. This powder can be fully dispersed back in polar solvents, forming excellent dispersions with more than 94.9% of the GO flakes being monolayers.



SEM image of a GO particle from bulk powder

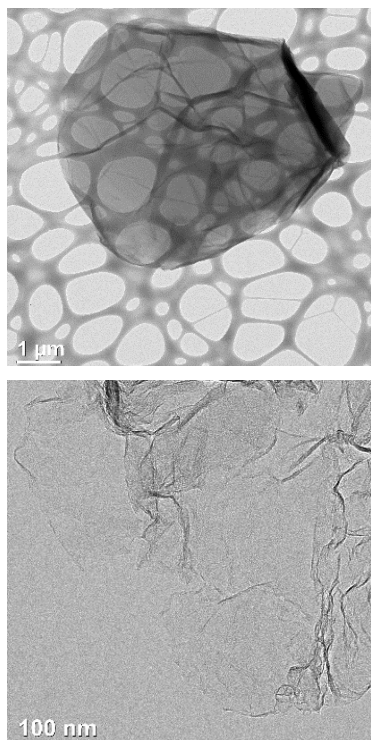


SEM of graphene oxide nanosheets deposited on a silicon wafer



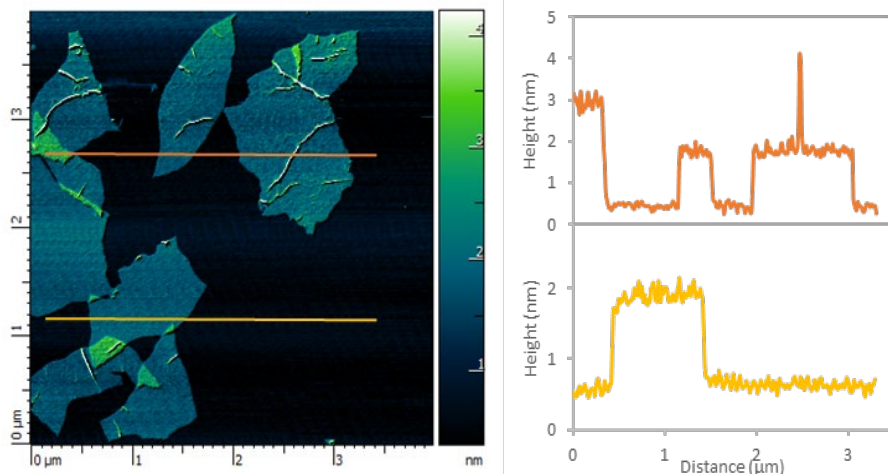
TEM MICROSCOPY

TEM images of the bulk powder featuring crumpled cabbage-like GO particles. Unlike the traditional flat GO sheets, this structure prevents the aggregation of the material and facilitates the redispersion of GO into various solvents. The images also show the morphological wrinkles and folds in the GO sheets.



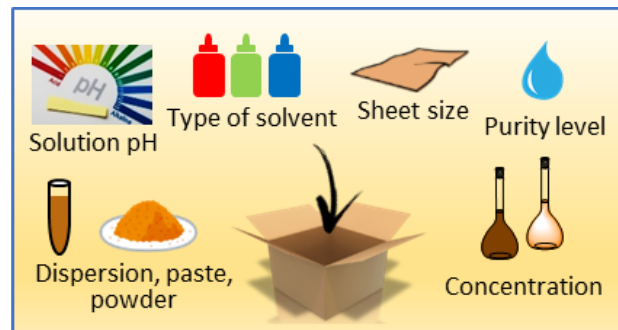
AFM MICROSCOPY

AFM of Supreme GO nanosheets deposited on a mica substrate indicate the successful exfoliation down to the monolayer level. The height of the Supreme GO sheets is 0.9-1.5 nm thanks to the rich functional groups on their surface as well as the local wrinkles and folds that can be seen throughout the image.



GRAPHENE OXIDE CUSTOMIZED TO YOUR NEEDS

Pimata offers graphene oxide in different formulations that are designed to be customized for every kind of use. Our major focus is to provide single layer graphene oxide product with superior optical and chemical properties. We can also provide graphene oxide in the powder form, paste or as dispersions. Additional parameters we can precisely control are the sheet size, concentration of GO in the dispersion, solution pH, the type of solvent used for making the dispersion and purity level as a function of the pH or the ionic conductivity of the GO solution. Pimata has the capability to meet your requirements. Tell us your specs and we will customize the GO for your application.



Disclaimer: The information claimed is believed to be accurate. Pimata holds no guarantee to the accuracy of data and no liability in connection with damages when using the product.

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