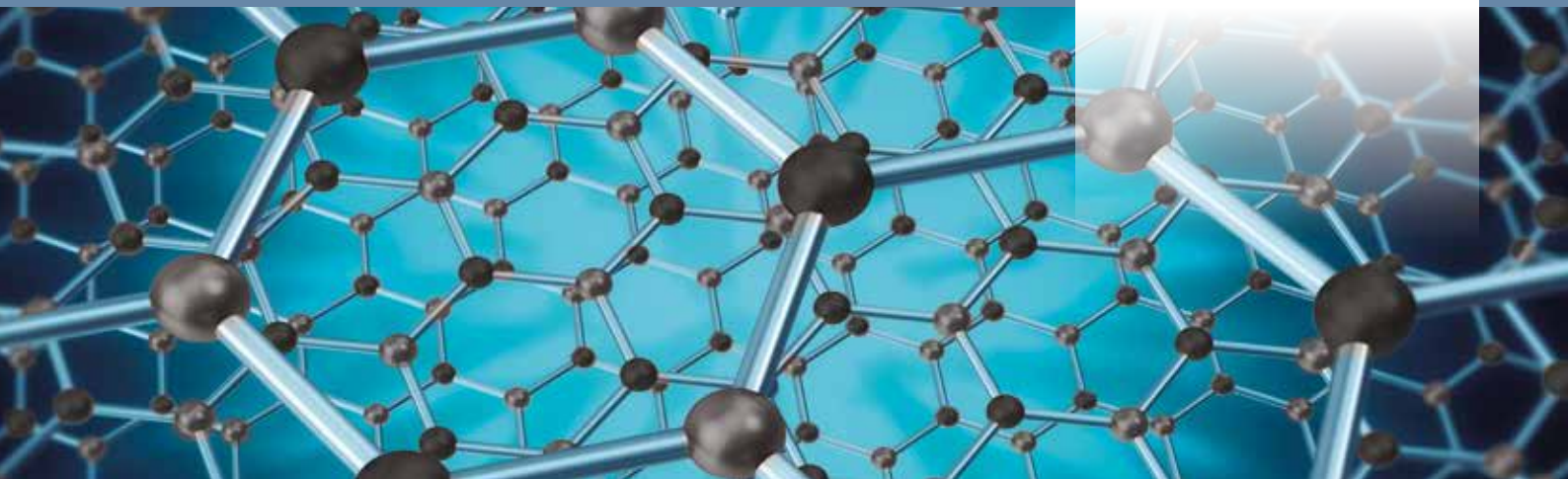


Elicarb[®] Premium Grade Graphene Powder and Elicarb[®] Premium Grade Graphene Dispersion (AQ)

Advanced Materials



High quality graphene products from a reliable supply partner.

Thomas Swan is a world leader in the manufacture and supply of carbon nanomaterials which is underpinned by our position as an independent, international, performance and fine chemicals manufacturer.

Elicarb[®] Premium Grade Graphene products are few layer graphene nanoplatelets with consistent particle size and high conductivity.

Elicarb[®] Premium Grade Graphene is provided in two product formats:

Elicarb[®] Premium Grade Graphene powder:

Few layer graphene powder.

Elicarb[®] Premium Grade Graphene Dispersion (AQ):

A water/surfactant dispersed GNP at a concentration of 1g/litre.

The advantages of using a “top-down” graphite exfoliation are:

Carbon sp² layers are substantially undamaged and non-oxidised

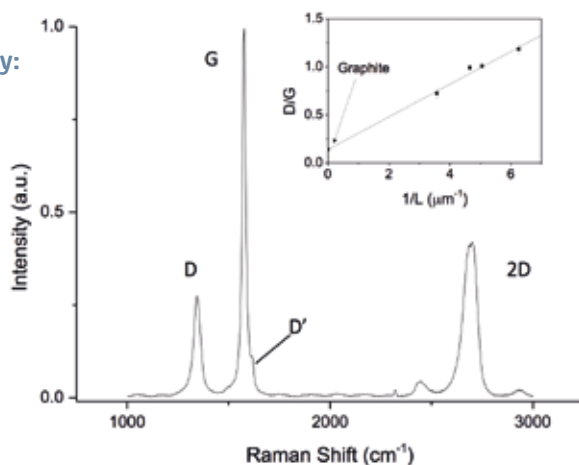
Contaminants of non-carbon elements such as oxygen (Hummers method) and metal catalyst residues are low

Particle size is uniform and in 0.5µm to 1.0µm range

Highly conductive few layer graphene platelets (FLGs) are produced

Robust process delivering a consistent product

Raman spectroscopy:



Raman spectrum (532nm excitation wavelength) of Elicarb[®] Premium Grade Graphene Powder shows a high quality sp² carbon network with D/G ratio of 0.28 and D/D' of 5.0. Analysis of D/G ratio against flake size (inset) confirms that D-band is associated with plate edge effects rather than in-plane defects. The low D/D' ratio is also consistent with edge effects only. The 2D band shape indicates the presence of few layer graphene flakes with an average of 5-7 atomic layers.

Limited warranty information: The information contained herein is offered in good faith and is believed to be accurate at the time of printing. This information should not be used as a substitute for your own quality control and/or testing procedures to ensure that our products are safe, effective and fully satisfactory for the intended end use. Suggestions of use shall not be taken as inducements to infringe any patent.


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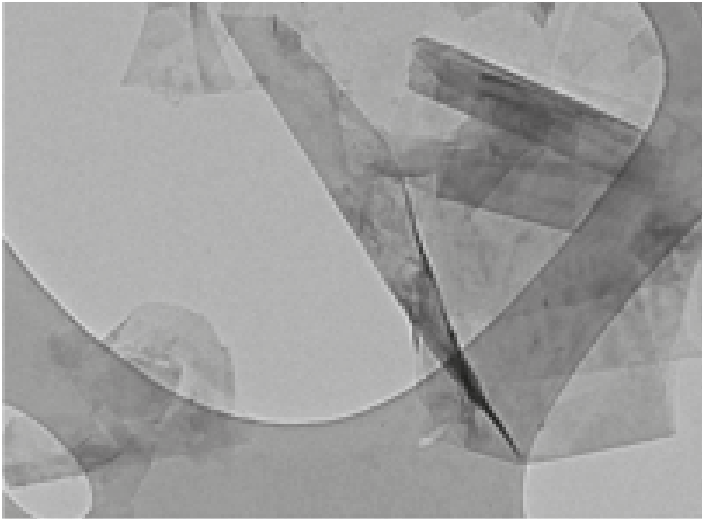
For additional information
please contact:

elicarbsales@thomas-swano.co.uk
www.thomas-swano.co.uk



Committed to Responsible Care

Platelet Size – Transmission Electron Microscopy (TEM):



TEM image of Elicarb® Premium Grade Graphene Powder (displayed on carbon grid) shows good quality FLGs of varying layer thicknesses.

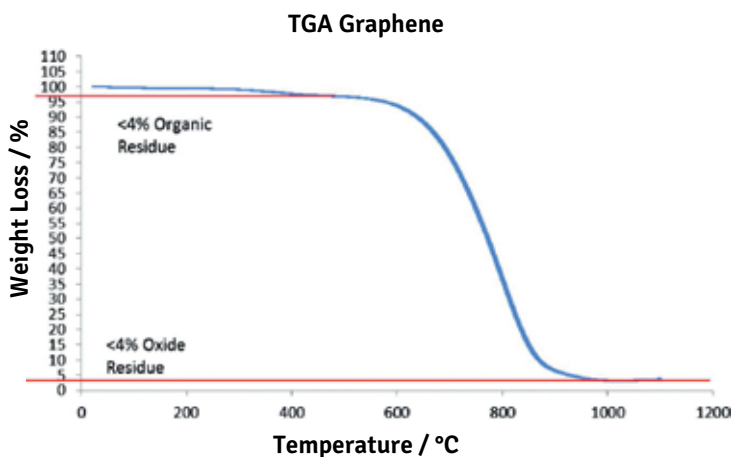
High quality graphene products from a reliable supply partner.

Sheet Resistance (4 point probe):

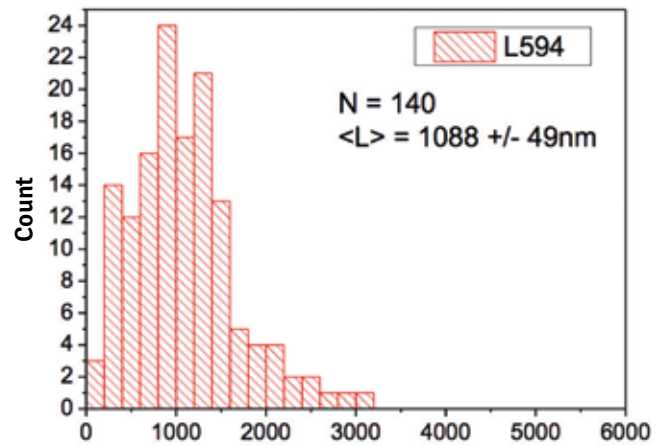
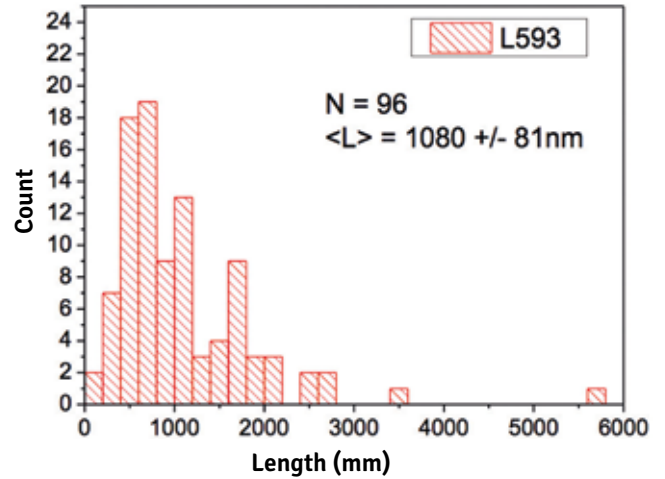
A test film is prepared by vacuum filtration of water dispersion of graphene to produce a ca 25 micron thick film. The film is not washed with further solvent after filtration. The sheet resistance is measured with the 4-point probe using on average 10mA current, the thickness of the film is measured to give a sheet resistance normalised to 25 micron.

Typical Sheet Resistance is 10 (± 5) Ω/□ for a 25µm film.

Thermogravimetric Analysis (in air):

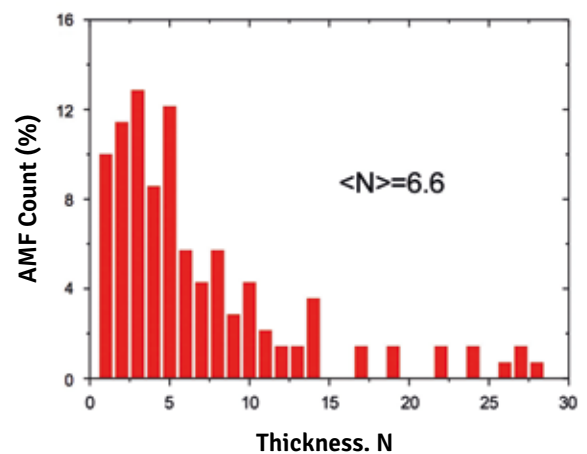


TGA to 1100°C in air of Elicarb® Premium Grade Graphene Powder shows a weight loss of ca.4 % at 350°C which is decomposition of surfactant residues followed by the primary decomposition of graphene at 803°C. The manufacturing process can be tuned to reduce or eliminate surfactant residues. A final residue of ca. 4%w/w remains at 1100°C which is due to inorganic residues within the graphite raw material.



Number average platelet size of Elicarb® Premium Grade Graphene Powder by TEM image analysis shows an average X-Y platelet dimension of 1000nm. TEM analysis of multiple batches reveals excellent particle size repeatability from the exfoliation and extraction process.

Platelet Thickness by Atomic Force Microscopy:



AFM analysis of mean thickness in NMP exfoliated FLGs shows an average plate thickness between 5 and 7 carbon layers.