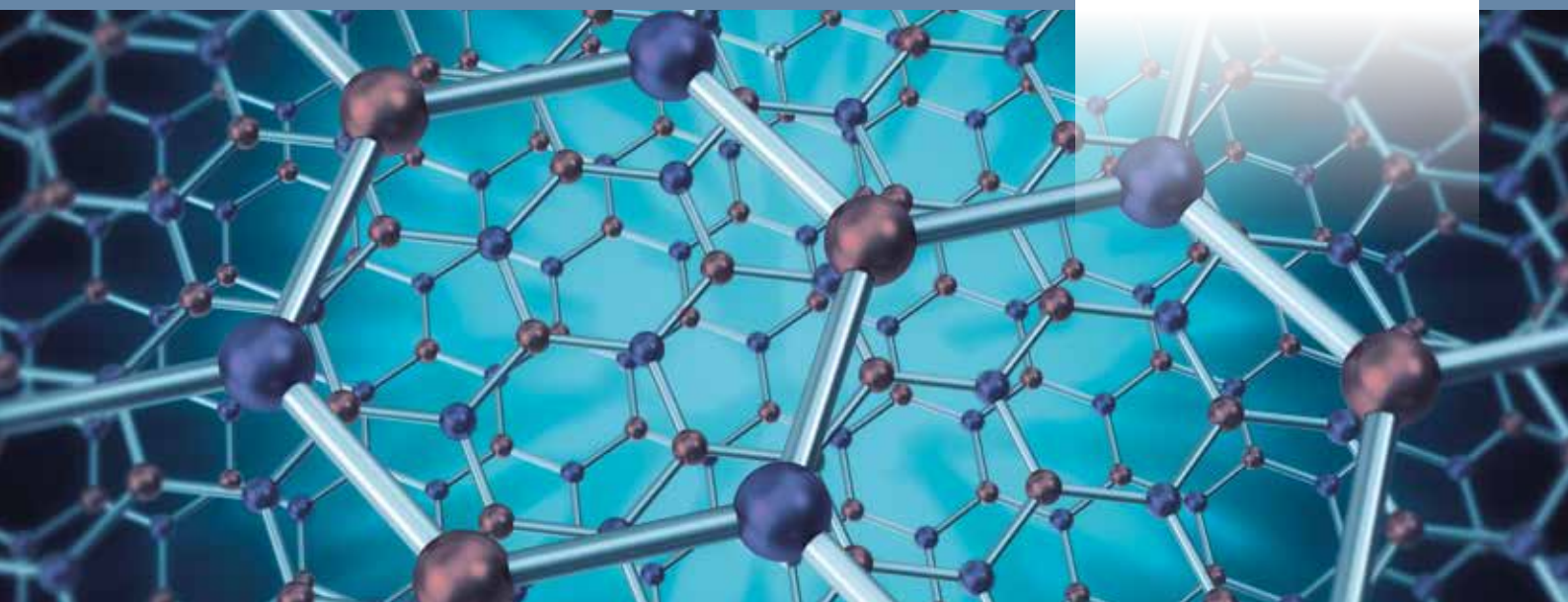


Elinova® 2D Boron Nitride Products

Advanced Materials



A new range of high quality 2D platelet 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.

We supply a range of quality **Elicarb® Graphene** products, first launched in 2014. We have now extended our product range to include 2-dimensional hexagonal boron nitride (**Elinova® Boron Nitride**) platelets. These products are manufactured using our proprietary Direct Liquid Exfoliation process.

Elinova® Boron Nitride:

2D boron nitride platelets are manufactured by Direct Liquid Exfoliation of high purity h-boron nitride. This is a proprietary process which produces well-controlled, high aspect ratio platelets without utilising aggressive chemistries such as acids or oxidising agents. These 2D boron nitride products will benefit from the attributes of h-boron nitride (see inset) with some enhanced properties due to the high aspect ratio of the 2D platelets. These include high gas and moisture barrier, mechanical reinforcement and thermal conductivity.

Elinova® Boron Nitride Product:

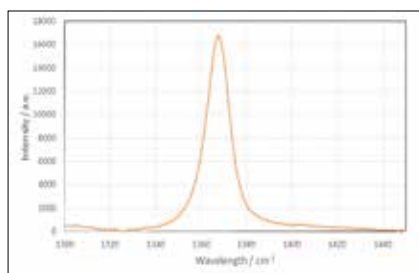


Figure 1: Raman spectroscopy of **Elinova® Premium Grade Boron Nitride Powder** confirms the presence of h-boron nitride and the absence of possible impurities such as B_2O_3 .

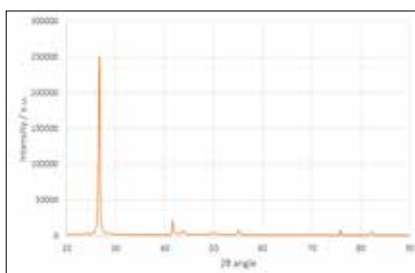


Figure 2: X-ray powder diffraction of **Elinova® Premium Grade Boron Nitride Powder** confirms a pure, crystalline h-boron nitride material with no intercalation between layers.

Properties of hexagonal Boron Nitride (h-BN):

High dielectric strength ⁽¹⁾ 900 MV/m

High thermal conductivity ⁽²⁾ 2000 W/m.K

White powder, allowing versatility in product design and transparency at low loading.

Chemically inert and thermally stable to 1000°C in air. ⁽³⁾

h-boron nitride (raw material) is approved for use in cosmetics and food contact applications.


Thomas Swan
Advanced Materials

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2. M. J. Meziani, ChemPhysChem 2015, 16, 1339, DOI: 10.1002/cphc.201402814
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4. Lin et al. Composites Science and Technology, 90, 2014, 123, DOI:10.1016/j.compscitech.2013.10.0189
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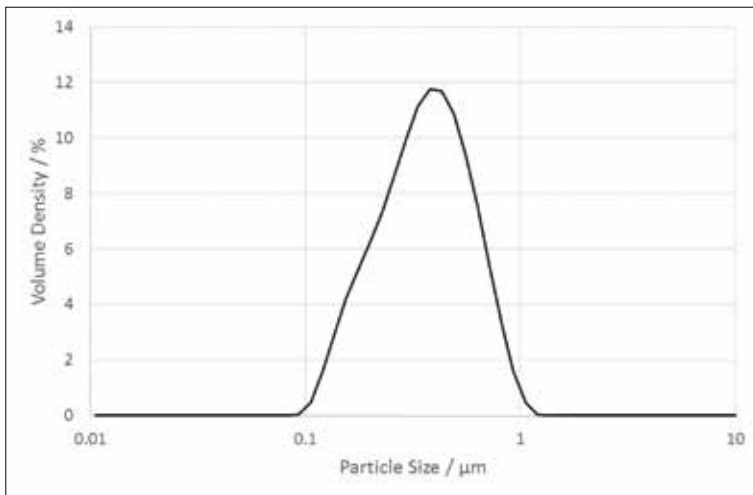


Figure 3: Particle size distribution measured by Malvern Mastersizer 3000 laser light scattering for **Elinova® Premium Grade Boron Nitride Dispersion**. Laser light scattering technologies can be subject to error when analysing high aspect ratio particles, however the results are in good agreement with the TEM images.

Applications:

Elinova® Boron Nitride has broad utility in a range of industries which include electronics, automotive, packaging and speciality oils and lubricants. **Elinova® Boron Nitride** products are highly complementary to **Elinova® Elicarb® Graphene** products with a contrasting white colour and dielectric properties.

Typical Applications for Elinova® Boron Nitride:

- Thermal interface materials for electronic and lighting devices.
- Printable high dielectric strength coatings.
- Mechanical reinforcement in plastics, composites and thermosets.
- Thermal conductivity enhancement in dielectric oils and polymers. ⁴
- Oxygen and moisture barrier additive for plastic films and containers. ⁵

Thomas Swan 2D Boron Nitride products:

Product Name	Ref No	Description
Elinova® Premium Grade Boron Nitride Powder	PR1151	Few layer h-BN platelet powder, with typical lateral size 0.5µm. Dielectric with high thermal conductivity
Elinova® Boron Nitride Dispersion	SP8078AQ	A water/surfactant based dispersion of few layer h-boron nitride nanoplatelets at a concentration of ca.20g/litre
Elinova® Materials Grade Boron Nitride Powder	PR1153	Multi-layer h-BN platelet powder, with typical lateral size 1µm. Dielectric with high thermal conductivity

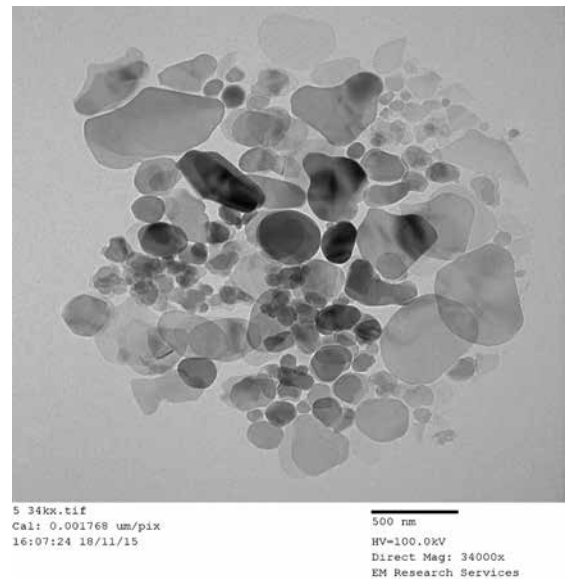


Figure 4: Transmission Electron Microscopy (TEM) of **Elinova® Premium Grade Boron Nitride Powder** demonstrating the existence of few layered platelets with X-Y dimensions between 700nm and 10nm. Note the transparent particle (top middle) and the overlapping particles (middle right) which indicate few layer platelets. The uniform transparency across the platelets is indicative of a flat platelet structure.



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