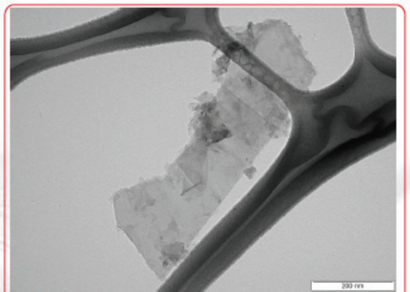
STREM Graphene Nanoplatelets

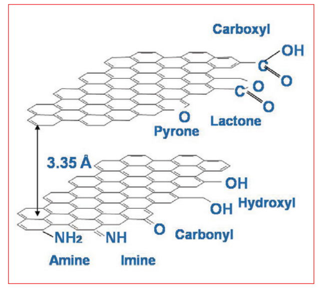
metals · inorganics · organometallics · catalysts · ligands · custom synthesis · cGMP facilities · nanomaterials



TEM Image of nearly transparent platelet - 750 m^2/g

Graphene nanoplatelets with an average thickness of the 5 – 10 nanometers are offered in varying sizes up to 50 microns. These interesting nanoparticles are comprised of short stacks of platelet-shaped graphene sheets that are identical to those found in the walls of carbon nanotubes, but in a planar form. Hydrogen or covalent bonding capability can be added through functionalization at sites on the edges of the platelets.

Enhanced ***barrier properties*** and improved ***mechanical properties*** (stiffness, strength, and surface hardness) can be achieved with the *graphene nanoplatelets* due to their unique size and morphology. The *nanoplatelets* are also excellent excellent ***electrical*** and ***thermal conductors*** as a result of their pure graphitic composition.



Graphene nanoplatelets are 6-8 nm thick with a bulk density of 0.03 to 0.1 g/cc, an oxygen content of <1% and a carbon content of >99.5 wt% and a residual acid content of <0.5 wt%, and are offered as black granules.

Graphene nanoplatelet aggregates are aggregates of sub-micron platelets with a diameter of <2 microns and a thickness of a few nanometers, a bulk density of 0.2 to 0.4 g/cc, an oxygen content of <2 wt% and a carbon content of >98 wt%, and are offered as black granules or black powder.

Graphene NanoPlatelets

Catalog No.	Width
06-0210	5 microns
06-0215	15 microns
06-0220	25 microns

Graphene Nanoplatelet Properties

Density	Parallel to Surface	Perpendicular to Surface
Thermal Conductivity	3,000 watts/m-K	6 watts/m-K
Thermal Expansion	4-6 x 10^6 m/m/dg-K	0.5-1.0 x 10^6 m/m/dg-K
Tensile Modulus	1,000 GPa	na
Tensile Strength	5 GPa	na
Electrical Conductivity	10^7 siemens/m	10^2 siemens/m

Graphene NanoPlatelet Aggregates

Catalog No.	Surface Area
06-0225	300 m^2/g
06-0230	500 m^2/g
06-0235	750 m^2/g

Note**:** *Nanoplatelets have naturally occurring functional groups like ethers, carboxyls or hydroxyls that can react with atmospheric humidity to form acids or other compounds. These functional groups are present on the edges of the particles and their wt% varies with particle size.

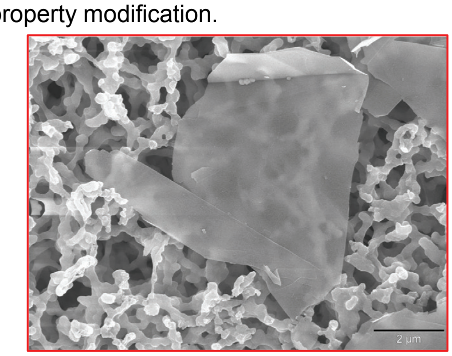
Wide Applicability

Because of their unique nanoscale size, shape, and material composition, *graphene nanoplatelets* can be used to improve the properties of a wide range of polymeric materials, including thermoplastic and thermoset composites, natural or synthetic rubber, thermoplastic elastomers, adhesives, paints and coatings. The *graphene nanoplates* are offered in a granular form that in water, organic solvents and polymers with the right choice of dispersion aids, equipment and techniques.

Used alone, *graphene nanoplatelets* can replace both conventional and nanoscale additives while expanding the range of properties being modified. Used in combination with other additives, they help reduce cost and expand property modification.

With *graphene nanoplatelets*, you can:

- Increase thermal conductivity and stability
- Increase electrical conductivity
- Improve barrier properties
- Reduce component mass while maintaining or improving properties
- Increase stiffness
- Increase toughness (impact strength)
- Improve appearance, including scratch and mar resistance
- Increase flame retardance



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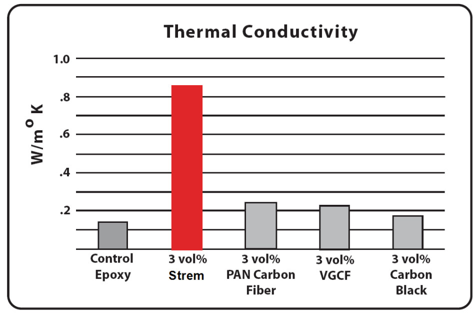
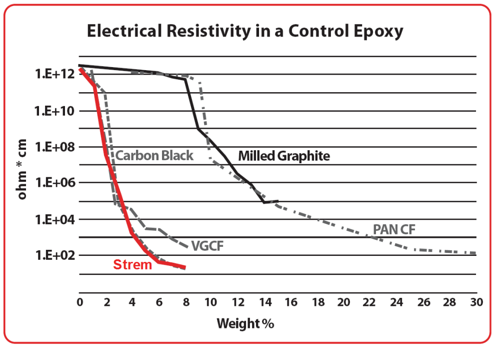
Enhancing Thermal Conductivity

Like other carbon-based technologies, the graphene sheets that form the *nanoplatelets* are both thermally and electrically conductive. Unlike nanotubes or carbon fibers, however, the platelet morphology provides lower thermal contact resistance at lower loading levels, resulting in higher thermal conductivity vs. other carbon particles or fibers.

Graphene nanoplatelets can be used to lower the *coefficient of thermal expansion* (CTE) of most polymers and increase ultimate use temperature (T_{ult}) values. Dimensional stability and operating temperature range are also increased, making polymers modified with Strem's *nanoplatelets* excellent for dimensionally critical parts in thermally demanding environments.





Increasing Electrical Conductivity

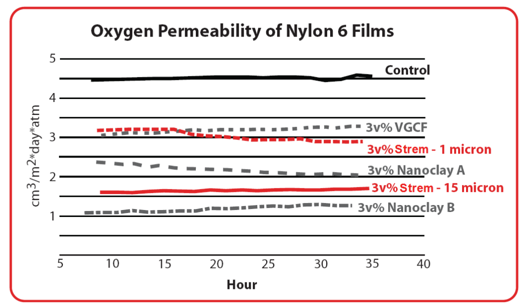
The graphene sheets that form these *nanoplatelets* are also highly conductive and create an effective conducting network at *low loading levels* in most polymeric materials. ESD and EMI/RFI shielding capabilities are typically achieved at loading levels of 2 - 3 wt% in thermoset resins and 5 -7 wt% in thermoplastics.

Unlike many conductive additives, though, these *nanoplatelets* do not negatively affect the base resin's mechanical and aesthetic properties, nor are they abrasive to tooling as metal flake and fiber can be.

Reducing Permeability

When compounded into a polymer film or solid part, the *graphene nanoplatelets* significantly reduce the *Permeability* or *Diffusion Coefficients* of the matrix material. The high *aspect ratio* of the platelets – which are far wider than they are thick – makes them effective at low loading levels, which helps reduce cost and impact on other properties.

Laboratory tests with nylon and other thermoplastic resins show several orders of magnitude improvements in permeability when compounded with *graphene nanoplatelets*. Permeability is significantly influenced by the particle size of the additive, and in general, larger diameter particles provide greater reductions in permeability. In laboratory tests, 15-μm particles compare favorably with most nanoclays and clearly outperform other carbon-based materials.



Multifunctionality

The ***multifunctional property improvements*** offered by *graphene nanoplatelets* make them ideal additives for applications where several property improvements are required. Significant processing or material cost savings can be achieved by reducing or eliminating the need for multiple films or expensive lamination processes.

- ❖ Achieve effective electrical conductivity with improved stiffness and toughness in cost-sensitive applications
- ❖ Improve the cross-fiber electrical conductivity and ESD and thermal conductivity of carbon-fiber composites
- ❖ Produce lower cost nanotube-containing conductive polymers with improved barrier properties
- ❖ Render fiberglasss electrically conductive without requiring any changes in processing or fabrication procedures
- ❖ Improve barrier properties while also enhancing stiffness, strength, and scratch-resistance without reducing toughness
- ❖ Impart inherent electrical conductivity for dissipation of static electricity and excellent barrier protection for use in applications involving flammable gases or liquids

06-0210	**Graphene nanoplatelets (6-8 nm thick x 5 microns wide)** black platelet	25g 100g
06-0215	**Graphene nanoplatelets (6-8 nm thick x 15 microns wide)** black platelet	25g 100g
06-0220	**Graphene nanoplatelets (6-8 nm thick x 25 microns wide)** black platelet	25g 100g
06-0225	**Graphene nanoplatelets aggregates (sub-micron particles, surface area 300m^2/g)** black platelet	25g 100g
06-0230	**Graphene nanoplatelets aggregates (sub-micron particles, surface area 500m^2/g)** black platelet	25g 100g
06-0235	**Graphene nanoplatelets aggregates (sub-micron particles, surface area 750m^2/g)** black platelet	25g 100g

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