POLYNANOSIL

Polynanosil is a mixture of homogeneous dispersed elongated silica nanoparticles in epoxy resin.

Polynanosil provides significant improvements on key properties of cured epoxy resin such as tensile modulus, flexural modulus and fracture toughness. The uniform dispersion of oval shaped silica nanoparticles with aspect ratio > 1 and diameter below 100 nm is formed inside resin matrix (Figure 1). This particular shape of silica enhances the degree of reinforcement of resin over the spherical shaped particles. Surface modification of oval shaped silica nanoparticles is applied in our product to obtain a strong silica-resin bond formation and prevent the aggregation of silica particles. Only few percentages of oval shaped silica nanoparticles are required to form a high strength composite material; therefore, the viscosity of our product is extremely low and applicable for various applications.

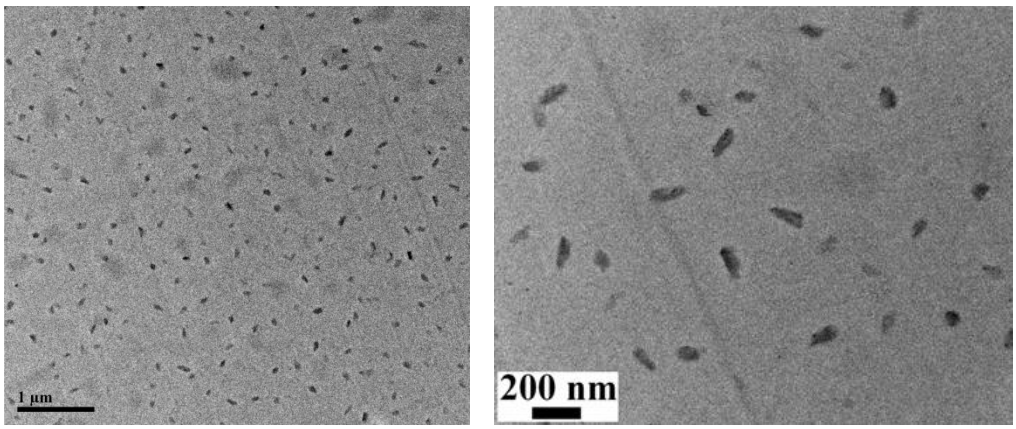

Figure 1. TEM micrograph shows uniform dispersion of oval shaped silica nanoparticles in resin matrix at 3 wt-% silica content.

Area of application

This product is suitable for use as adhesive, coating and composition of composite structure in various industries such as:

- Aerospace and aircraft

- Automobile
- Civil infrastructure
- Sporting goods
- Military industries
- Energy industries

Typical properties of nanocomposite and fiber reinforced polymer (FRP)

The mechanical properties of **Polynanosil** with 2-3 wt-% oval shaped silica nanoparticles are significantly enhanced over neat resin. From the fracture surface analysis of neat resin and nanocomposite with 3 wt-% silica content, higher crack resistance is obtained from this product due to the uniform dispersion of nano-sized silica in resin without large aggregation and strong silica-matrix bonding (Figure 2). By using this strong and uniform composite system, the superior tensile modulus, flexural modulus, impact strength can also be designed.

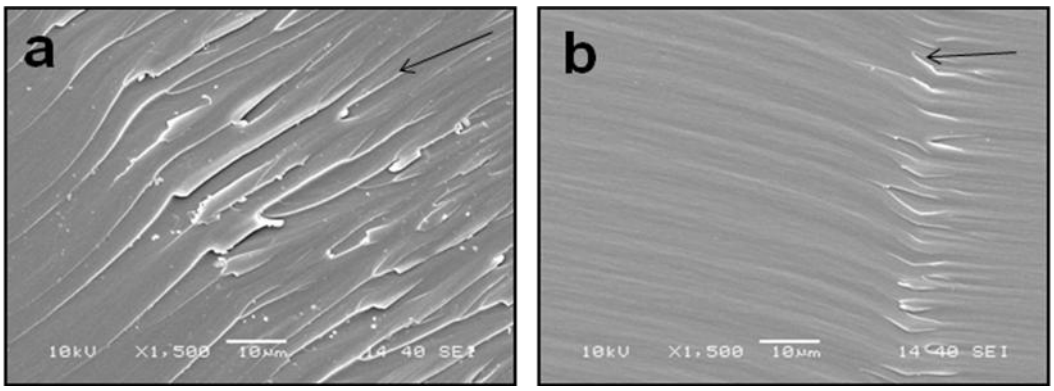

Figure 2. Rough fracture surface representing a high resistance to crack propagation is shown at slow crack region of this product (a), while smoother surface is achieved from neat resin (b). Arrows indicate the crack propagation direction.

Improvements on the interlaminar fracture toughness and overall mechanical properties are achieved by incorporating this product into fiber reinforced composite. Due to the low viscosity of this product with uniform silica dispersion, it can easily be penetrated through layers of filber fabrics. Thus, it is applicable to various types of molding systems.

Typical properties of cured Polynanosil nanocomposite compared with neat resin

Property	Neat resin	Polynanosil	Test Method
Tensile modulus (GPa)	2.5±0.7	3.0±0.2	ASTM D638-03
Flexural modulus (GPa)	2.4±0.1	3.0±0.9	ASTM D790-96
Fracture toughness (K_{Ic},MPa.$m^{1/2}$)	0.4±0.2	0.7±0.01	ASTM D5528-01

Typical properties of cured carbon fiber reinforced Polynanosil nanocomposite compared with neat resin

Property	Neat resin	Polynanosil nanocomposite	Commercial nanocomposite	Test Method
Tensile modulus (GPa)	63±8	71±6	65±5	ASTM D638-03
Flexural modulus (GPa)	53±4	56±7	55±5	ASTM D790-96
Interlaminar fracture toughness (K_{Ic},MPa.$m^{1/2}$)	340±35	390±85	290±70	ASTM D5528-01