Surface Modification Solutions for a plethora of applications

- Glass
- Energy
- Textiles
- Displays
- Ceramics
- Digital Inks
- Thermosets
- Biomaterials
- Printing Inks
- Quantum Dots
- Semiconductor
- Thermoplastic
- Chromatography
- Nano-Composites
- Imaging & Printing
- Advanced Composites
- Optics & Optoelectronics

Understanding characteristics that may affect the performance of surface modified micro-particles can dramatically improve the performance in many applications and markets:

**Micro-Particle Properties**
- morphology
- crystal lattice
- polymorphism
- semiconductive
- surface characteristics

**Micro-Particle Dramatic Effects**
- rheological behavior
- hiding power, color strength
- dispersion, solubility, polarity
- photo, chemical, thermal stability
- mechanical & electrical properties
- moisture & corrosion resistance

**Gelest, Inc.**
provides focused technical solutions for surface modification applications and maintains the capabilities to handle flammable, corrosive and air-sensitive materials. Headquartered in Morrisville, PA Gelest is recognized worldwide as an innovator, manufacturer and supplier of commercial and research quantities of silanes, metal-organics and silicones, serving advanced technology markets through a material science driven approach.

For additional information on Gelest’s Surface Modification Technology or to inquire on how we may assist in Enabling Your Technology, please contact:

Gelest, Inc.
11 East Steel Rd.
Morrisville, PA 19067
Phone: 215-547-1015
Fax: 215-547-2494
micro-particle@gelest.com

www.gelest.com

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Innovating Particle Functionalization

Gelest provides chemistries and deposition technologies for micro-particle modifications that dramatically enhance:

- **Color**
- **Polarity**
- **Adhesion**
- **Dispersion**
- Rheological Behavior
- Photo, Chemical, Thermal Stability
- Moisture & Corrosion Resistance
- Mechanical & Electrical Properties
COUPLING THE PARTICLE TO THE APPLICATION

### Surface Modification Solutions

**Solutions**

- Adhesive, Rapid phase deposition: silanes, chlorosilanes, methoxysilanes, hydrochlorides, and hydrolysis solutions are prepared at ~80°C. The systems are heated to 130-140°C for 2-4 hours with the substrate to be treated. It is washed with the solvent. The substrate is then immersed by air or expanded air, dried. No further treatment is necessary. This reaction involves direct metal displacement of the chloride by HCl to form a bond as indicated in the surface. If the chloride is treated with silica, hydrogen chloride is formed, substrates should be treated at ~150°C for 4-4 hours. Bulk deposition methods absorb water is present in the substrate. This method is more effective for large-scale preparations and rigorous controls must be established to achieve reproducible results. More reproducible coverage is obtained with mono-chlorosilanes.

- Bulk deposition onto powders, e.g. filler treatment, is usually accomplished by a spray-on method. In this method the silane is used as a simple additive. Compounds can be prepared for the addition of alkoxysilanes to dry-blends of polymer and filler prior to compounding. Generally 0.2 to 1.0 weight percent of silane is dispersed by spraying the silane in an alcohol carrier onto a preblend. The addition of the silane is non-dispersed filler is not desirable. The sols may be prepared as in toluene, bring to reflux and then the toluene brought to reflux allowing sufficient silane to enter vapor phase through partial pressure contribution. In general, substrate temperature should be maintained above 50° and below 120° to promote reaction. Cyclic azasilanes are preferred for small particles and nano-particles. Vapor phase deposition, silanes can be applied to substrates under dry aprotic conditions by chemical vapor deposition methods. These methods favor monolayer deposition. Although under proper conditions, almost all silane, can be applied to substrates in the vapor phase, above vapor pressures 0.1 torr at 28°C, have shown in the preparative research, that most applications. In foundry chamber desilning, substrates are supported above at a substrate, into which the mixture is subjected to sufficient temperature to remove the vapor phase. Alternatively, reactors can be heated and silane evaporation is observed. In still manner, the silane can be prepared and applied to the reactor. The substrate is kept 0.5-10% of the substrate to be treated. It is washed with the solvent. The solvent is then applied until silane evaporation is observed. No further treatment is necessary. More reproducible coverage is obtained with monochlorosilanes.

### Chemical Considerations

- Solid surface modifications, e.g. surfactant, surfactant effect, is preferred for small particles and nano-particles. Vapor phase deposition, silanes can be applied to substrates under dry aprotic conditions by chemical vapor deposition methods. These methods favor monolayer deposition. Although under proper conditions, almost all silane, can be applied to substrates in the vapor phase, above vapor pressures 0.1 torr at 28°C, have shown in the preparative research, that most applications. In foundry chamber desilning, substrates are supported above at a substrate, into which the mixture is subjected to sufficient temperature to remove the vapor phase. Alternatively, reactors can be heated and silane evaporation is observed. In still manner, the silane can be prepared and applied to the reactor. The substrate is kept 0.5-10% of the substrate to be treated. It is washed with the solvent. The solvent is then applied until silane evaporation is observed. No further treatment is necessary. More reproducible coverage is obtained with monochlorosilanes.
Solutions

**Chemical Considerations**

**Surface Properties**

- Oleophilicity
- OleopHobicity
- Zeta Potential
- Hydrophilicity
- Hydrophobicity

**Bonding Mechanisms**

- Ionic Bonding
- Metallic Bonding
- Covalent Bonding
- Aromatic Bonding
- Hydrogen Bonding

**Interpenetrating Polymeric Networks**

- Crystalinity Modification
- Wetting & Surface Area Effects

**Inputs**

- **Particle**
  - Siliceous
  - Natural
  - Synthetic
  - Non-siliceous
- **Particle Size Distribution**
- **Physical Properties**
  - Density
- **Specialty**
  - Metallic
  - Phosphorescent
  - Fluorescent
  - Synthetic
  - Natural

**Outputs**

- **Substrates**
  - Speciality
  - Non-siliceous
  - Siliceous

**Masonite**

- **Vapor Phase Deposition**
  - Silanes can be applied to substrates under dry aprotic solvents by chemical vapor deposition methods. These methods favor monolayer deposition.

- **Bulk Deposition**
  - Silanes and metal-organics onto micro-particles.

- **Slurry Deposition**
  - For large scale preparations and rigorous controls must be established to ensure reproducible results.

- **Twin-cone Blenders**
  - Are used for blending or drying steps.

- **Reactor for Slurry**
  - Separate filtration bars are used for slurry treatment of micro-particles.

**Monolayer Polylayer**

- **Mixed Deposition**
  - Layer-by-layer deposition

- **Ribbon Blenders**
  - Are used for slurry treatment of micro-particles.

- **Laminates are used for bonding or surface modifications of micro-particles.**

- **Ribbon Blenders**
  - Are used for slurry treatment of micro-particles.

- **Reactor for Slurry**
  - Separate filtration bars are used for slurry treatment of micro-particles.
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