



# Meeting the Demands of Renewable Energy:

Generation, Capture and Storage

## Organosilicon and Metal-Organic Materials

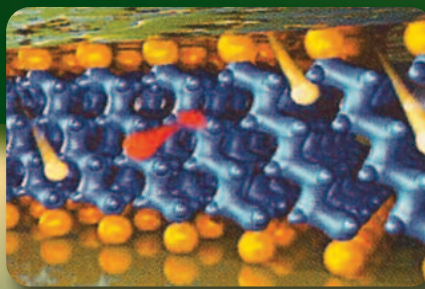
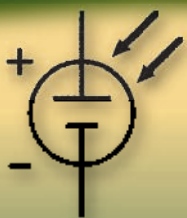


**Organosilicon and Metal-Organic materials from Gelest are helping to meet the challenges for:**

- *Electroactive and Dielectric Materials - including membranes, electrodes and electrolytes*
- *Water Immiscible Fluids - for electrolyte, heat transfer and lubricant applications*
- *Structural Materials - including mesoporous ceramics and advanced composites*
- *Component Protection Materials - including passivation and encapsulation*
- *Sol-Gel Coatings - for AR (anti-reflection) and abrasion resistance*
- *Optical Materials - including band-gap and index materials*

# Generation

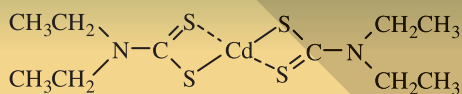
Photovoltaic -



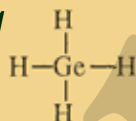
## Band-gap Materials :

- Gelest offers precursors for vapor phase and solution phase deposition of Groups III-V, II-VI, and IV (Si/Ge) band-gap materials.
- CdTe/CdSe Cadmium Telluride, Cadmium Selenide and CIGS (Copper Indium Gallium Selenide) precursors are available for vapor phase, solution and pyrolytic deposition in applications ranging from large area arrays to quantum dots.
- Gelest offers volatile silylated and non-volatile dithiocarbamate and carboxylate metal chalcogenide precursors.
- Triple Junction GaAs Solar Cells / Metamorphic Multijunction Solar Cells. Germanium layers provide lattice match for growth of GaAs in multi band-gap photovoltaics.

AKC159.8



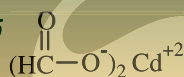
GEG5001



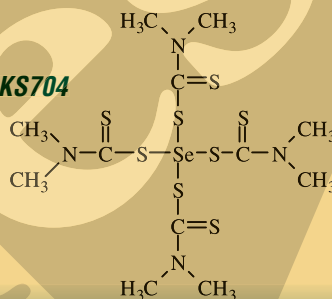
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CXCD045



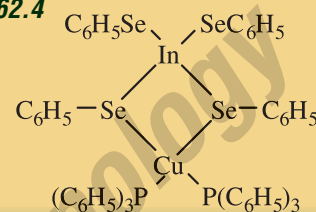
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SIB1871.0



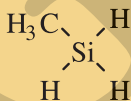
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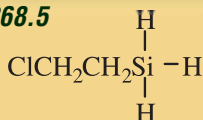
## Passivation Layers - coatings that prevent carrier recombination :

- Silicon Nitride, Silicon Carbide and Silicon Carbonitride perform a variety of roles on the topmost active layer of photovoltaic devices. Gelest provides both single-source precursors and precursors used in combination with a secondary reactant such as ammonia or, with PECVD systems, nitrogen.

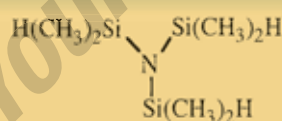
SIM6515.0



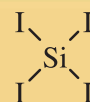
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SIT8715.5



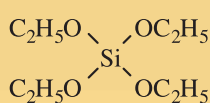
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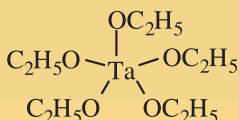
## Anti-Reflection / All-Angle Coatings :

- Gelest provides a wide-range of index materials based on silicon, germanium, tantalum and other metal-organics for direct use or by thermal or hydrolytic conversion. These materials are used in step-index, gradient-index or quarter-wave stacks. Applications range from AR-coatings to Bragg mirrors and reflectors.

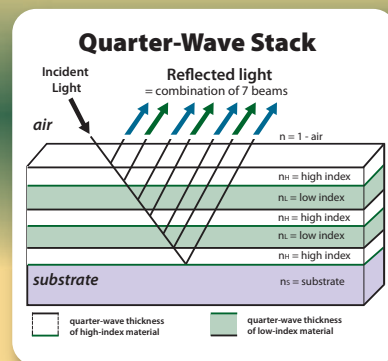
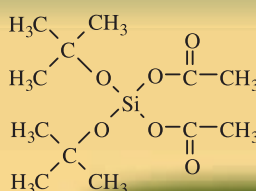
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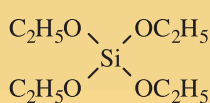
AKT810



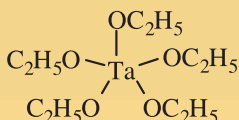
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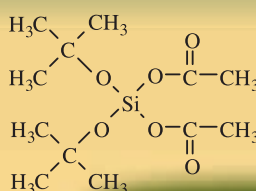
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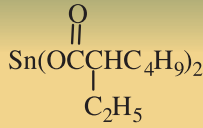


# Generation

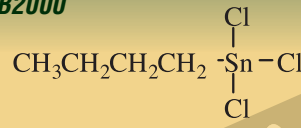
## Transparent Conductive Oxide Coatings -TCOs SnO:F, ZnO:Al, SbTO:

- Gelest offers a range of materials that can be deposited without the vacuum requirements of sputtering techniques. Alternative material technologies that eliminate indium include zinc, antimony and tin based oxides that can be fluorine doped.

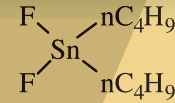
**SNB1100**



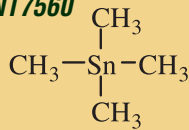
**SNB2000**



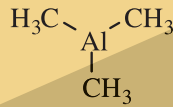
**SND3255**



**SNT7560**



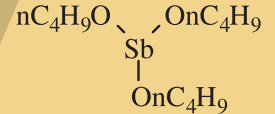
**OMAL086**



**OMZN017**



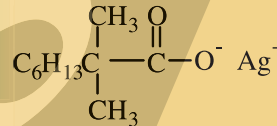
**AKA090**



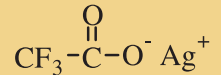
## Conductive Pastes:

- Organic compatible silver salts are used in conjunction with silver powder to formulate front-side grid-like contacts.

**CXSV060**



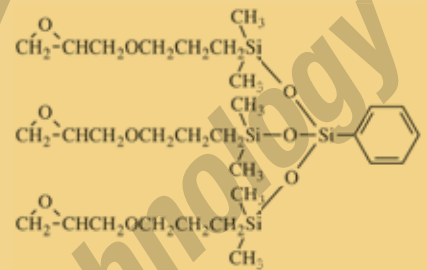
**CXSV080**



## Barriers:

- Backside Polymer Films and Encapsulants.

**SIT8715.6**



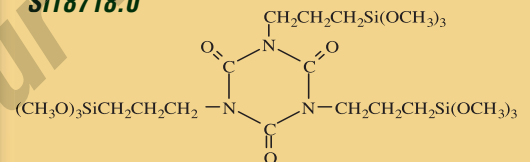
## Optically Clear Silicone Encapsulants

*silicone on glass for concentration PV*



## Lifetime Extension for Polyester Back-Sheets

**SIT8718.0**

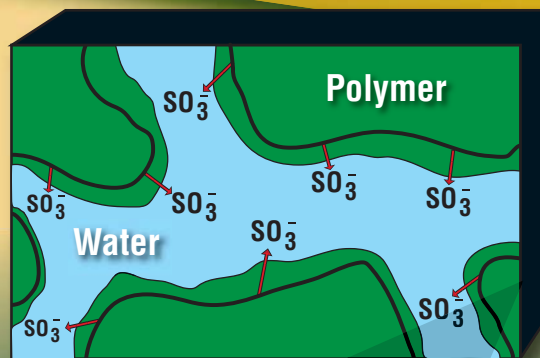
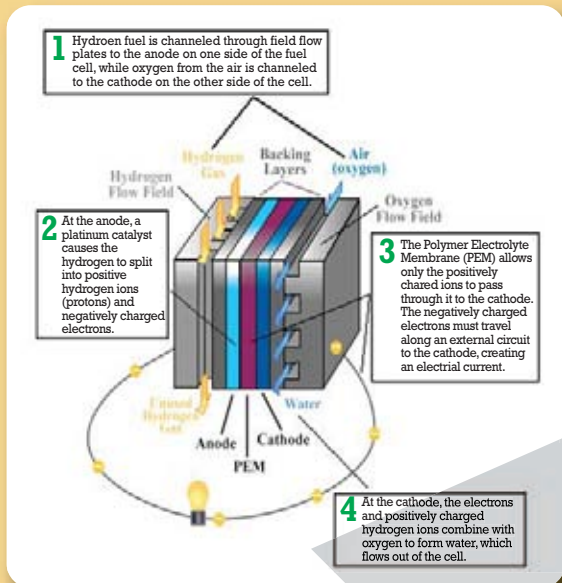


## Adhesion Promoters

- **Siliglide™ 10** – low-friction, “glide” surfaces for glass, vitreous and metal substrates
- **Seramic™ SI-A** – dielectric, thermally resistant SiO<sub>2</sub> coatings, deep UV curable
- **Gelest OE41** – optically clear 1.41 flexible 2-component low temperature cure
- **Gelest OE42** – optically clear 1.42 flexible 2-component low temperature cure
- **Gelest OE43** – optically clear 1.43 flexible 2-component low temperature cure
- **Aquaphile™ AQ** – water-wettable anti-fog coating for glass and ceramics

# Generation

## Fuel Cells – Proton Exchange Membrane FC



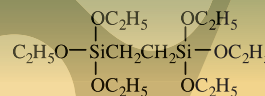
### Monomers for High Temperature Proton Exchange Membranes Inorganic Scaffold Materials:

- Silica, alumina, aluminosilicates. Functionalizing agents for porous silica membranes.

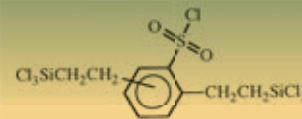
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SIB1817.0

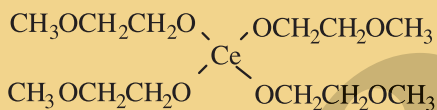


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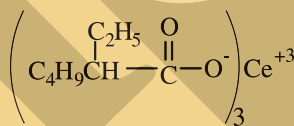


## Electrodes, Solid State Electrolytes, Proton-conducting solids – Ceria (cerium oxides) by sol-gel and pyrolytic deposition

AKC186

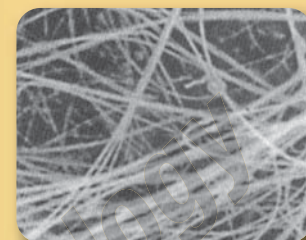
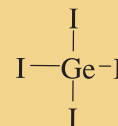


CXCE041

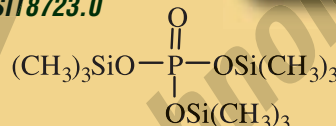


## Catalysts – Nanowires

GEG5800

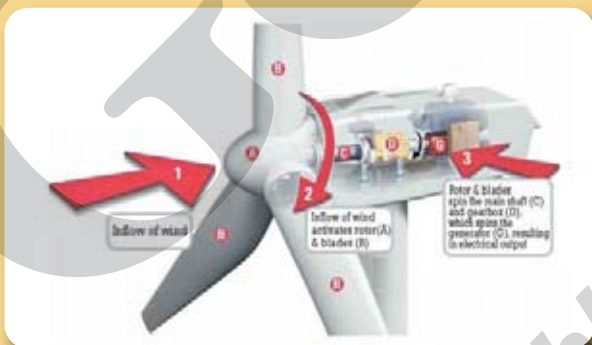


SIT8723.0



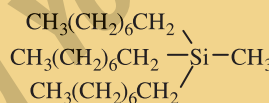
## Proton Mobility Facilitators

## Wind Turbine

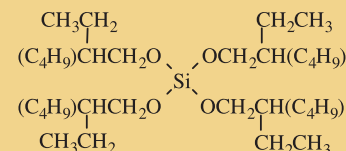


## Turbine Lubricants for Low Temperature Environments

SIM6577.0



SIT7283.0

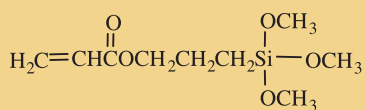


## Silahydrocarbons

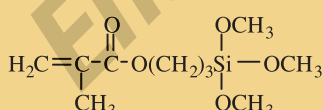
## Silicate Esters

## Coupling Agents for Composites

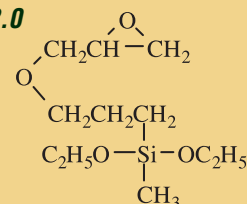
SIA0200.0



SIM6487.4



SIG5832.0



## High-Speed Polyester

## Polyester

## Moisture Resistant Epoxy

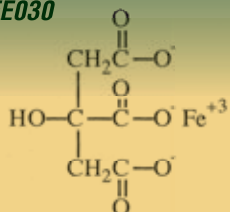
# Capture & Storage

## Advanced Batteries –

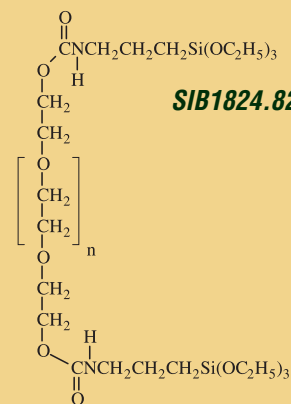
### Lithium Cathodes:

Solid Polymer, Gel Electrolyte Systems, Li-SPE (lithium solid polymer electrolyte systems).

CXFE030



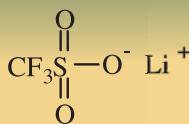
Cathode Fabrication



SIB1824.82

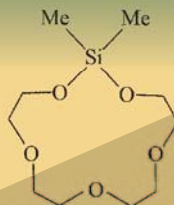
Ureasil Gel Electrolytes

CXLI083



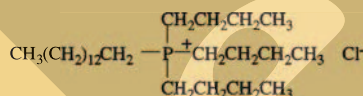
Li Salts

SID4220.5



Li, Na Complex

OMPH066

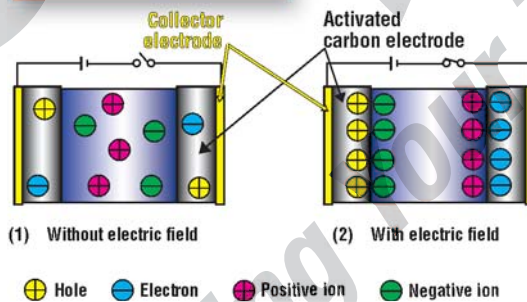


Ionic Liquids provide broad voltage windows, high ionic conductivities and low vapor pressure

## Capacitors –

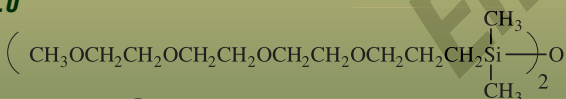


### Ultracapacitor



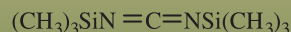
- Ultracapacitors (electrochemical double layer capacitors EDLCs) offer high power and energy density by utilizing high surface area porous carbon electrodes and ultra-thin dielectric distances. Broader voltage windows are anticipated with hydrogel or organic electrolytes.

SIB1550.0



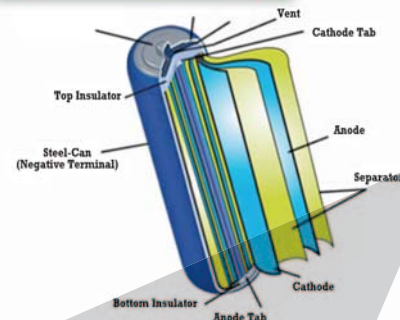
Gel Electrolytes

SIB1856.0

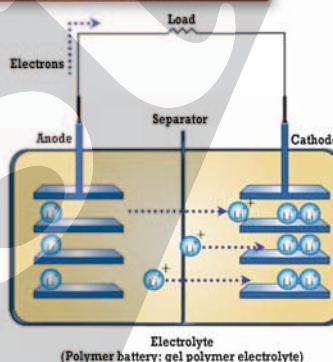


Electrolyte Acid Scavengers

### Cylindrical lithium-ion battery



### Lithium-ion rechargeable battery Discharge mechanism





## ***Gelest, Inc.***

***Provides technical expertise in silicon and metal-organic materials for applications in alternative energy. The core manufacturing technology of Gelest is silanes, silicones and metal-organics with the capability to handle flammable, corrosive and air sensitive materials.*** Headquartered in Morrisville, PA Gelest is recognized world-wide as an innovative manufacturer and supplier in commercial and research quantities, serving advanced technology markets through a material science driven approach.

For additional information on Gelest's Silicon and Metal-Organic based products or to enquire how we may assist in ***Enabling Your Technology***, please contact:



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