Information About *Dow Corning*® Brand CVD Materials

In an industry that continues to evolve and develop new integrated circuits, there are many challenges to overcome. With issues such as high aspect ratios, low thermal budgets, and critical electrical and mechanical property requirements to address, finding the right silicon-based CVD precursor solutions for your devices is critical. Dow Corning is committed to helping you solve your most difficult challenges by continuing to develop and commercialize new molecules for all your next-generation, thin-film deposition needs.

For 60 years, Dow Corning has combined silicon materials expertise with strong technical support, working toward innovative solutions to your current and future challenges.

With a long history of successfully serving the electronics industry, Dow Corning:

- Is the world's largest supplier of polycrystalline silicon
- Is the world's largest supplier of both spin-on and CVD low-κ (<3) dielectric materials for IC fabrication
- Provides 100% vertical integration from starting materials (sand) to semiconductor-grade silicon-based gases and chemicals
- Offers basic materials research and development, with pilot sampling through large-scale chemical production performed throughout a globally integrated organization
- Has successfully completed numerous tier-one customer audits
- Leads production of specialty chemicals: organosilanes, siloxanes, silicon-based resins and polymers

CVD Precursor Technology
Dow Corning provides synthesis, purification and testing of silicon-based precursor materials for use in next-generation low-κ, high-κ, gap fill and low-temperature CVD applications. Dow Corning partners in technology development to service industry needs.

Low-κ and Copper Barrier Applications

Type: Multifunctional CVD Precursor

Physical Form: Silicon source specialty gas/liquid

Typical Molecules: *Z3MS*™, *Z4MS*™, *ZTOMCATS*™, *Z2DM*™, organosilanes, organosiloxanes, others

Special Properties: High purity; semiconductor grade

Potential Uses: Formation of silicon carbide, silicon oxycarbide and silicon dioxide thin-film dielectrics; typical film applications include interlevel dielectric, etch stops, hard mask and copper barrier layers

Low-Temperature Applications

Type: Multifunctional CVD precursors

Physical Form: Silicon source specialty liquid

Typical Molecules: ZHCDS (hexachlorodisilane), chlorosilanes, others

Special Properties: Highly reactive molecules; high purity; semiconductor grade

Potential Uses: Formation of front end-of-line low-temperature deposition of thin films (i.e., silicon oxide, silicon nitride, epitaxial silicon, poly silicon, etc.); typical applications include spacer nitrides, spacer oxides, etch stop, cap nitride, STI liner, engineered source/drain and engineered substrates

High-κ Applications

Type: Multifunctional CVD precursors

Physical Form: Silicon source specialty liquid

Typical Molecules: Aminosilanes, chlorosilanes, others

Special Properties: High purity; semiconductor grade

Potential Uses: Formation of silicon oxide or metal silicates; typical applications include logic gate oxide and memory capacitor oxide

Gap Fill Applications

Type: Multifunctional CVD precursor

Physical Form: Silicon source specialty liquid

Typical Molecules: Organosilanes, organosiloxanes, others

Special Properties: High purity; semiconductor grade

Potential Uses: Formation of silicon oxide thin-film dielectrics; typical film applications include shallow trench isolation (STI) and pre-metal dielectric (PMD) gapfill

DOW CORNING

Sample Synthesis Capability

Dow Corning has the capability to provide customers with new materials for next-generation applications, and provide a smooth transition from lab-scale to high-volume manufacturing (HVM).

- Multiple lab-scale processes dedicated to custom synthesis and purification of new materials for the semiconductor industry
- Construction of a new pilot-scale facility dedicated to rapid supply of sample quantities of semiconductor-grade CVD precursor materials
- Extensive packaging and testing capabilities to meet semiconductor standards

CVD Research and Development

- 200-mm PECVD dielectric thin-film growth
- 13.56 MHz PlasmaTherm 790 system, RIE, PE and Triode plasma modes, 30-7000 mT, 50-550°C (Class 1000)
- AMAT DxZ P5000 dielectric deposition system (Class 10)
- Room temperature HDP PECVD system (Q4-2002)
- Real time plasma analysis by mass spectroscopy

Thin Film Characterization

- Multichannel spectroscopic ellipsometry with wafer mapping 190-1000 nm wavelength, 300-mm wafer capability (3 systems)
- FT-IR wafer mapping with compositional analysis
- UV-Vis spectroscopy
- 200-mm wafer RTP-based thermal desorption spectrometer

Electrical Testing

- Sputtered metal gate C-V analysis 10 mHz-10 MHz, quasistatic C-V analysis
- Leakage and breakdown testing to 1000 VDC
- Bias temperature stress (BTS) and triangular voltage sweep (TVS) mobile ion testing
- TDDB and QDB reliability testing
- Inert ambient hot chuck probe stations 100-200 mm to 300°C wafer temperature

Mechanical Testing

- Wafer curvature/stress testing 20-450°C
- AFM-based nano-indentation testing
- In-situ temperature-humidity testing
- mELT, four-point bend and stud pull adhesion testing
- On-wafer particle analysis to 0.2 µm particle size

Total Support

Product Finder – Dow Corning features a unique interactive product finder on our website that can help you pick the right materials for your applications. You can access the product finder at www.dowcorning.com/electronics by selecting “Technical Data” on any of our product family pages.

Analytical, Environmental and Physical Testing – We have expertise to share on a wide range of testing to monitor quality, on specialized testing for troubleshooting, or to simulate accelerated service conditions.

Equipment Recommendations – Through many years of providing electronics materials, Dow Corning has developed strong alliances with key equipment suppliers worldwide. Save time and expense by taking advantage of these partnerships to ensure the optimum integration of material and processing.

Consultation with Technical Experts – Have our experts visit your facility or join us at one of our global application centers to work together on your material and processing needs.

Tutorials – CVD Precursor Materials tutorials, including an overview and a processing tutorial, can be found on our website. The tutorials are accessible from the product family pages or the left-hand navigation bar under Technical Resources.

Product/Application Information

HOW TO USE

Dow Corning® CVD Precursors leverage processing technology developed for standard dielectric film deposition. They are compatible with most standard equipment and processes. Refer to the Product Information table for specific details.

STORAGE AND SHELF LIFE

Shelf life is indicated by the “Use By” date found on the product label. Refer to the Typical Properties table for indicated shelf life.

LIMITATIONS

These products are neither tested nor represented as suitable for medical or pharmaceutical uses.

SAFE HANDLING INFORMATION

PRODUCT SAFETY INFORMATION REQUIRED FOR SAFE USE IS NOT INCLUDED IN THIS DOCUMENT. BEFORE HANDLING, READ PRODUCT AND MATERIAL SAFETY DATA SHEETS AND CONTAINER LABELS FOR SAFE USE, PHYSICAL AND HEALTH HAZARD INFORMATION. THE MATERIAL SAFETY DATA SHEET IS AVAILABLE ON THE DOW CORNING WEBSITE AT WWW.DOWCORNING.COM, OR FROM YOUR DOW CORNING REPRESENTATIVE, OR DISTRIBUTOR, OR BY CALLING YOUR GLOBAL DOW CORNING CONNECTION.

HEALTH AND ENVIRONMENTAL INFORMATION

To support customers in their product safety needs, Dow Corning has an extensive Product Stewardship organization and a team of Product Safety and Regulatory Compliance (PS&RC) specialists available in each area.

For further information, please see our website, www.dowcorning.com, or consult your local Dow Corning representative.

PATENT POSITION

The use of *Dow Corning® Z3MS™* CVD Precursor and *Dow Corning® Z4MS™* CVD Precursor to produce integrated circuits is claimed in one or more patents assigned to Dow Corning. Dow Corning intends to enforce these patents but will offer licenses thereunder. The purchase of *Dow Corning Z3MS* CVD Precursor and *Dow Corning Z4MS* CVD Precursor includes a license and the royalty is paid with the purchase. A listing of the licensed patents may be obtained by calling Dow Corning at 1-800-248-2481. Alternatively, if a written license is desired, it can be obtained at a comparable royalty rate upon written request, regardless of the source of the material.

LIMITED WARRANTY INFORMATION – PLEASE READ CAREFULLY

The information contained herein is offered in good faith and is believed to be accurate. However, because conditions and methods of use of our products are beyond our control, this information should not be used in substitution for customer's tests to ensure that Dow Corning's products are safe, effective, and fully satisfactory for the intended end use. Suggestions of use shall not be taken as inducements to infringe any patent.

Dow Corning's sole warranty is that the product will meet the Dow Corning sales specifications in effect at the time of shipment.

Your exclusive remedy for breach of such warranty is limited to refund of purchase price or replacement of any product shown to be other than as warranted.

DOW CORNING SPECIFICALLY DISCLAIMS ANY OTHER EXPRESS OR IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY.

DOW CORNING DISCLAIMS LIABILITY FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES.

PRODUCT INFORMATION

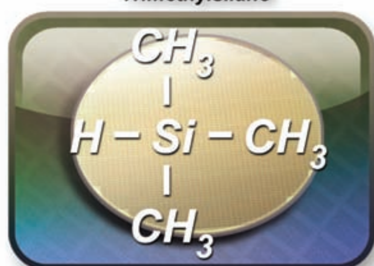
Dow Corning® Brand Product	Description	Features
Low-κ and Copper Barrier Applications		
Z3MS™ CVD Precursor	A silicon source specialty gas engineered for PECVD processes used to deposit thin-film dielectrics	Multifunctional CVD precursor, compatible with standard PECVD equipment, compatible with standard gas delivery systems, nonpyrophoric, environmentally friendly, not a global warmer; no ozone-depleting byproducts resulting from trimethylsilane decomposition, low cost of ownership
Z4MS™ CVD Precursor	A silicon source specialty liquid engineered for PECVD processes used to deposit thin-film dielectrics	Multifunctional CVD precursor, compatible with standard PECVD equipment, compatible with standard liquid delivery systems, nonpyrophoric
ZTOMCATS™ CVD Precursor	A silicon source specialty liquid engineered for PECVD processes used to deposit thin-film dielectrics	Compatible with standard PECVD equipment and standard liquid delivery systems; nonpyrophoric
Z2DM™ CVD Precursor	A silicon source specialty liquid engineered for PECVD processes used to deposit thin-film dielectrics	Compatible with standard PECVD equipment and standard liquid delivery systems; nonpyrophoric
Z-OMCATS CVD Precursor	A silicon source specialty liquid engineered for PECVD processes used to deposit thin-film dielectrics	Compatible with standard PECVD equipment and standard liquid delivery systems; nonpyrophoric
Organosilanes and Organosiloxanes	Silicon source specialty materials engineered for PECVD processes used to deposit thin-film dielectrics	Compatible with standard PECVD equipment and standard liquid delivery systems; nonpyrophoric
Low-Temperature Applications		
ZHCDS CVD Precursor	A silicon source specialty liquid engineered for LPCVD, APCVD and ALD processes used to deposit thin-film dielectrics	Compatible with standard LPCVD equipment and standard liquid delivery systems, nonpyrophoric
Chlorosilanes	Silicon source specialty materials engineered for LPCVD, APCVD and ALD processes used to deposit thin-film dielectrics	Compatible with standard thermal deposition equipment and standard liquid delivery systems, nonpyrophoric
High-κ Applications		
Aminosilanes	Silicon source specialty materials engineered for LPCVD, APCVD and ALD processes used to deposit thin-film dielectrics	Compatible with standard thermal deposition equipment and standard liquid delivery systems, nonpyrophoric
Gap Fill Applications		
Organosilanes and Organosiloxanes	Silicon source specialty materials engineered for LPCVD, APCVD and ALD processes used to deposit thin-film dielectrics	Compatible with standard thermal equipment and standard liquid delivery systems, nonpyrophoric

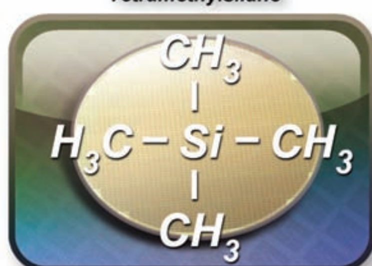
Dow Corning® Brand Product	Thin-Filmed Dielectrics Formed	Film Applications
Low-κ and Copper Barrier Applications		
Z3MS™ CVD Precursor	Silicon carbide (SiC), silicon-oxycarbide (a-SiOC:H), silicon-carbonitride (a-SiCN:H)	Copper diffusion barrier, etch stop, hard mask, low-κ interlevel dielectric, gap fill and passivation
Z4MS™ CVD Precursor	Silicon carbide (SiC), silicon-oxycarbide (SiCO), silicon-nitride (SiN)	Copper diffusion barrier, etch stop, hard mask and passivation
ZTOMCATS™ CVD Precursor	Silicon-oxycarbide (a-SiOC:H)	Low-κ interlevel dielectric
Z2DM™ CVD Precursor	Silicon-oxycarbide (a-SiOC:H)	Low-κ interlevel dielectric
Z-OMCATS CVD Precursor	Silicon-oxycarbide (a-SiOC:H)	Low-κ interlevel dielectric
Organosilanes and Organosiloxanes	Silicon-oxycarbide (a-SiOC:H)	Copper diffusion barrier, etch stop, hard mask and interlevel dielectric
Low-Temperature Applications		
ZHCDS CVD Precursor	Silicon nitride (SiN), silicon dioxide (SiO_2), polycrystalline and monocrystalline silicon (Si)	Spacer nitride, spacer oxide, etch stop, cap nitride, STI liner, gapfill, engineered source/drain and engineered substrates
Chlorosilanes	Silicon nitride (SiN), silicon dioxide (SiO_2), polycrystalline and monocrystalline silicon (Si)	Spacer nitride, spacer oxide, etch stop, cap nitride, STI liner, engineered source/drain and engineered substrates, epitaxial Si layers
High-κ Applications		
Aminosilanes	Hafnium silicates ($HfSiO_2$) and hafnium silicon oxynitrides (HfSiON)	Logic gate oxide and memory capacitor oxide
Gap Fill Applications		
Organosilanes and Organosiloxanes	Silicon dioxide (SiO_2)	PMD and STI gapfill

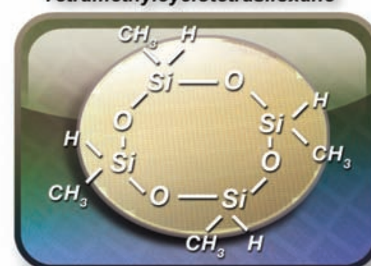
TYPICAL PROPERTIES

Specification Writers: Please contact your local Dow Corning sales office or your Global Dow Corning Connection before writing specifications on these products.

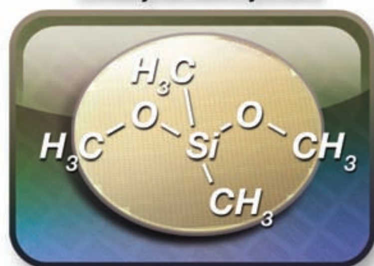
Dow Corning® Brand Product	Chemical Name	Chemical Formula	Shelf Life, from date of manufacture, months	Approx. Gas Density, mg/cc	Saturated Liquid Density at 25°C (77°F), g/cm³ (lb/ft³)	Molecular Weight, g/mol	Flash Point, °C (°F)
Low-κ and Copper Barrier Applications							
Z3MS™ CVD Precursor	Trimethylsilane	$(CH_3)_3SiH$	24	3.155	0.6141 (38.34)	74.19	-69.15 (-92.47)
Z4MS™ CVD Precursor	Tetramethylsilane	$(CH_3)_4Si$	24	N/A	0.6416 (40.05)	88.22	-28 (-18.4)
ZTOMCATS™ CVD Precursor	Tetramethylcyclotetrasiloxane	$(CH_3\text{-SiH-O-})_4$	12	N/A	0.99 (61.39)	240	29 (84)
Z2DM™ CVD Precursor	Dimethyldimethoxysilane	$(CH_3)_2Si(OCH_3)_2$	12	N/A	0.8585 (53.596)	120.2	-10.5 (13.1)
Z-OMCATS CVD Precursor	Octamethylcyclotetrasiloxane	$((CH_3)_2\text{-Si-O-})_4$		N/A	0.9480 (59.18)	296.7	57 (135)
Organosilanes and Organosiloxanes	Various	Various		—	Various	Various	Various
Low-Temperature Applications							
ZHCDS CVD Precursor	Hexachlorodisilane	$Cl_3Si_2Cl_3$		N/A	1.5438 (96.38)	268.9	80 (176)
Chlorosilanes	Various	Various		—	Various	Various	Various
High-κ Applications							
Aminosilanes	Various	Various		—	Various	Various	Various
Gap Fill Applications							
Organosilanes and Organosiloxanes	Various	Various		—	Various	Various	Various

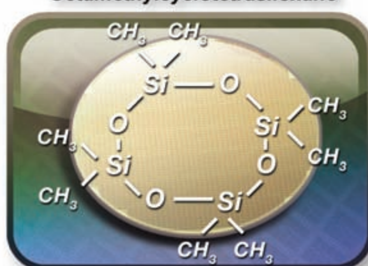


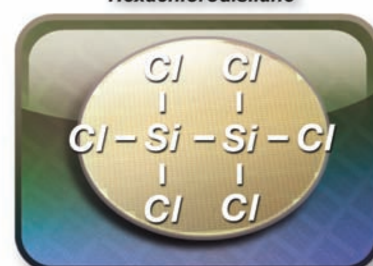




Dow Corning® Brand Product	Boiling Point at 760 mm Hg, °C (°F)	Melting Point, °C (°F)	Packaging	Saturated Vapor Pressure at 25°C (77°F), Torr (psia)	Safety	Upper Flammability Limit, approximate, % in air	Lower Flammability Limit, approximate, % in air	Autoignition Temperature, approximate, °C (°F)
Low-κ and Copper Barrier Applications								
Z3MS™ CVD Precursor	6.7 (44.06)	-135.9 (-212)	Mechanically polished, chemically passivated, CS with CGA 350 or DISS 632 outlet	1433 mm Hg (27.72 psia)	Liquified compressed gas, flammable, N.O.S. UN3161	51.30	1.38	245 (473)
Z4MS™ CVD Precursor	26.6 (80)	-99 (-146)	—	720 (13.92)	NA	37.9	1.0	330 (626)
ZTOMCATS™ CVD Precursor	135 (275)	-69 (-99.2)	—	7.71 (0.149)	NA	52	0.80	270 (518)
Z2DM™ CVD Precursor	81 (179)	-80 (-112)	—	66 (1.65)	NA	27.12	1.32	324 (615.2)
Z-OMCATS CVD Precursor	175 (348)	17.5 (63.5)	—	1.022 (0.0198)	NA	7.4	0.75	400 (751)
Organosilanes and Organosiloxanes	Various	Various	Various	Various	Various	Various	Various	Various
Low-Temperature Applications								
ZHCDS CVD Precursor	149 (300)	-1 (30)	—	6.84 (0.132)	NA	85.00	8.00	296 (565)
Chlorosilanes	Various	Various	Various	Various	Various	Various	Various	Various
High-κ Applications								
Aminosilanes	Various	Various	Various	Various	Various	Various	Various	Various
Gap Fill Applications								
Organosilanes and Organosiloxanes	Various	Various	Various	Various	Various	Various	Various	Various







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