Innovation

01

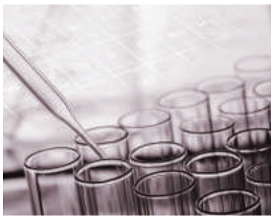
Harnessing Computational Technologies for Next-Generation Materials Design

- Our Computational Chemistry Technologies aim to accelerate materials discovery by > 10 times.
- We promote an integrated R&D system that can expedite R&D come to fruition.
- Research on the simulation of electron dynamics in EUV materials has started.

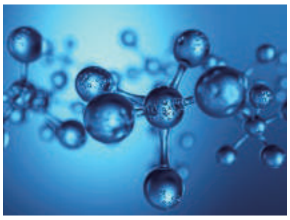
Paradigm of Material Discovery

- ✓ It used to take $10-100 million and 10 years to discover one new material.
- ✓ Acceleration of materials discovery was achieved by using simulations and AI.
- ✓ We expect to use quantum computing to make simulation and AI more efficient.
- ✓ Our ultimate goal is to speed up the discovery of new materials by >10 times.

1950s
Experimetnal Science

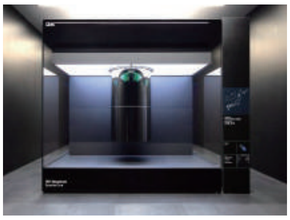


2000s
Simulation Science



2010s
AI and Data Science

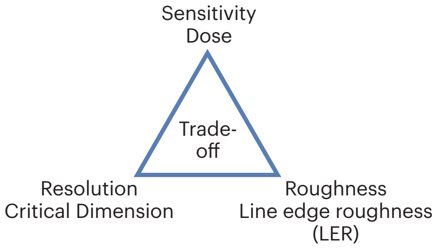
2020s
Quantum AI and Data Science

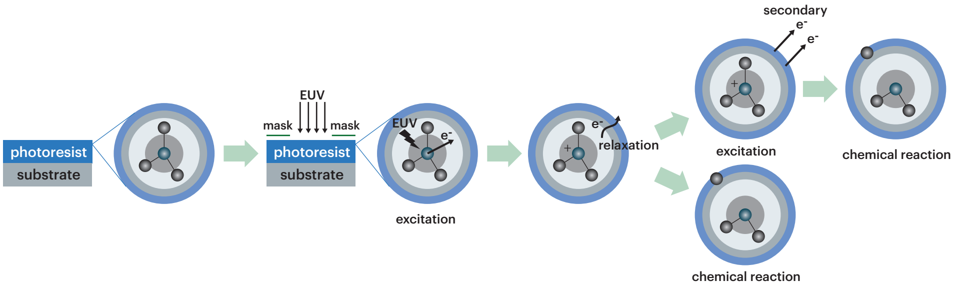


Exponentially Increasing Speed and Scale

Designing EUV Photoresist Molecules

- ✓ The EUV RLS tradeoff issue.
- ✓ Electron dynamics in materials greatly influence the tradeoff.
- ✓ It is tough for classical computers to perform accurate electron dynamics.
- ✓ Quantum Computational Chemistry enables simulation of exposure and processing chemistry with EUV photoemission.





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Wafer Processing

02

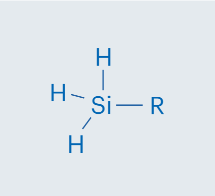
Silane Precursors

Gelest offers a broad portfolio of silanes and metal-organic reagents for ALD and CVD precursor materials in addition to custom preformulated materials for microelectronic applications requiring adhesion or use of primers.

ALD, ASD, CVD Precursors

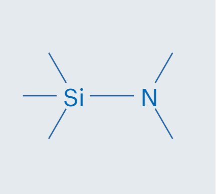
Cyclic Azasilanes

- Ring-opening upon exposure to –OH
- Highly selective to oxide vs. Si/SiN
- Extremely fast at Room Temp/Pressure



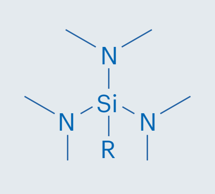
Trihydridosilanes

- Selective binding to metals over oxide
- R from 1 to 18, vinyl, phenyl, etc available



Silylating Agents

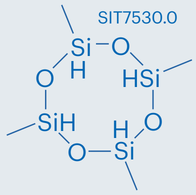
- Rapidly add $-SiMe_3$ to oxide surfaces
- Hexamethyldisilazane mimics, are superior in some applications

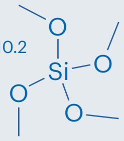


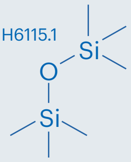
Amino Silanes

- Precursors for nitride, SiCN and low-k deposition

Low-k Precursors


SIT7530.0


SIT7510.2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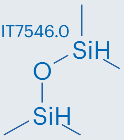
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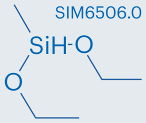
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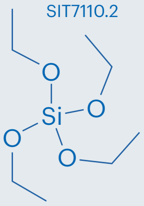
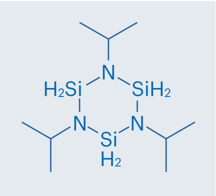
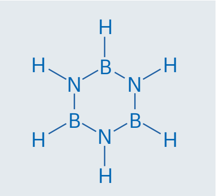

SIT7110.2

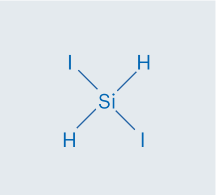
- **Advanced low-k / SiOC dielectric precursors**
- **Bridging and cyclic structures create porosity**
- **k-values as low as 2.2**
- **Many structural variants available**



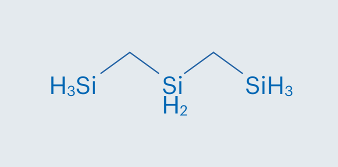
- SiN as low as 200 °C (PECVD)
- Flowable PECVD precursors



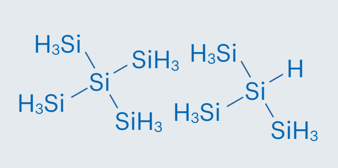
- Borazine to deposit Boron Nitride, Silicon Boronitride (SiBN), Boronoxynitride (SiBON), and Hexagonal Boron Nitride (h-BN)



- PECVD of SiN @ 400 °C



- High quality SiC @ 800 °C



- Higher growth rates than 6MS at constant temperature
- SiN via PECVD @ 250-300 °C

Wafer Processing

03

CMP Retainer Ring

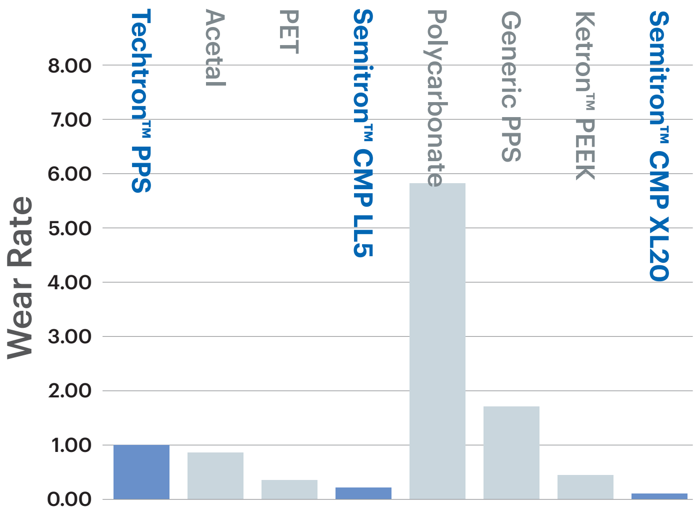
Product Lineups

- **Techtron™ PPS** – The ***market standard***, low moisture, exceptional chemical resistance & supreme properties.
- **Semitron™ LL5** – Offers ***extended life*** / Great cost performance.
- **Semitron™ XL-20** – Offers ***incredible durability***, **up to 20X** longer product lifespan. Best for overall cost reduction per wafer.

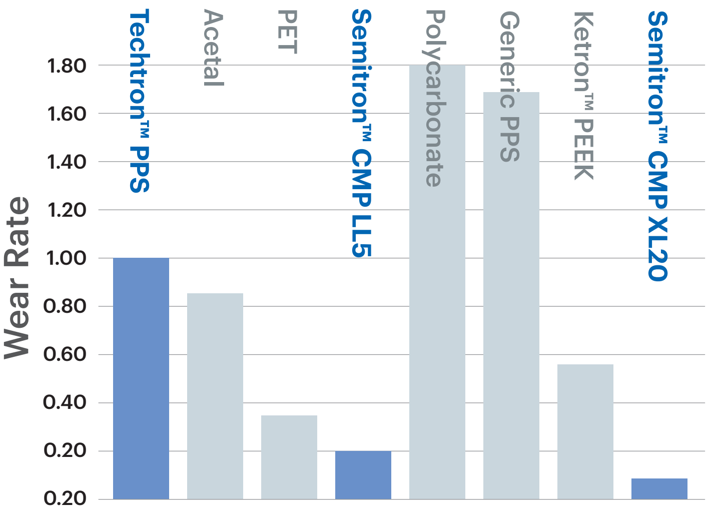
Wearing Performance

* Lower the number = More durable

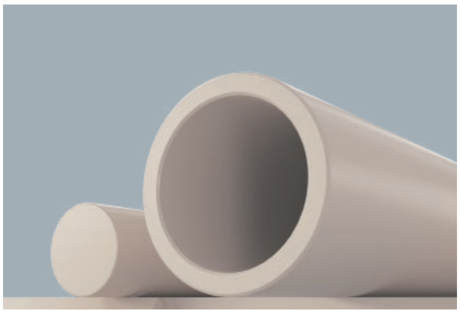
Abrasion Resistance – Tungsten



Abrasion Resistance – Tungsten

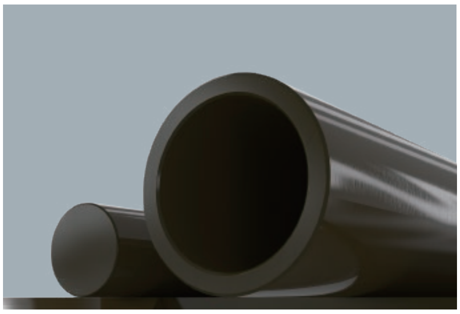


Features



Techtron™ 1000 PPS

Semitron™ CMP LL5 PET-P



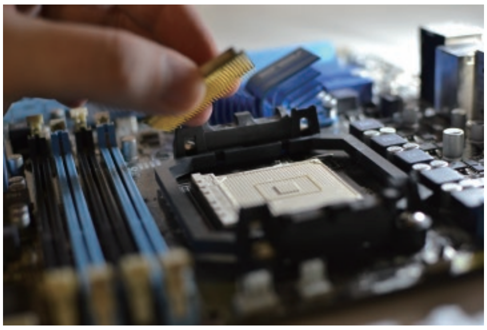
Semitron™ CMP XL20 PAI

Packaging

04

Back-end Test & Electronic Fixturing Solutions

Applications: Burn-in, test sockets & electronic fixturing



Standard materials

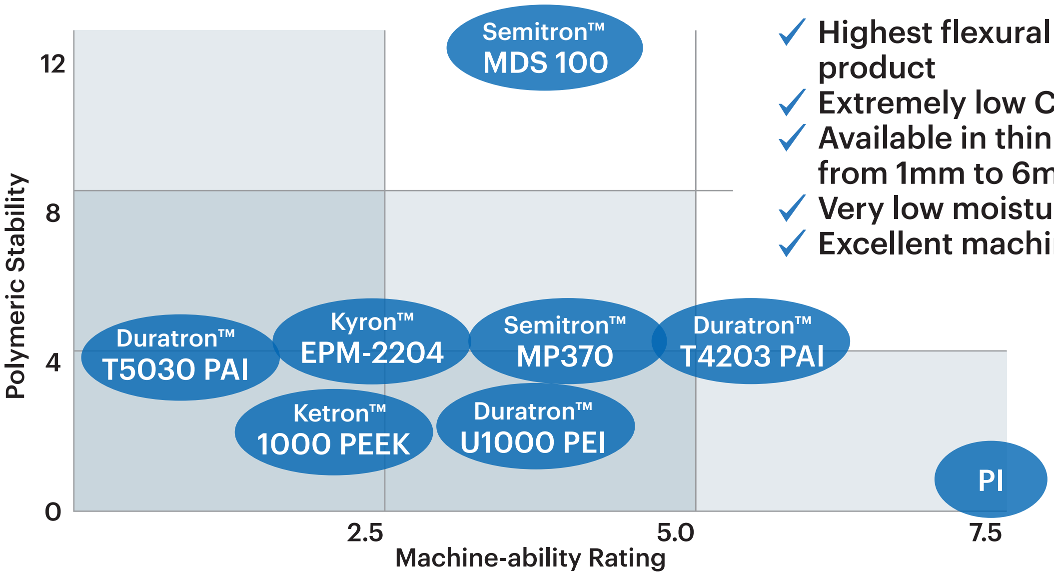
- Semitron™ MDS 100
- Semitron™ MP 370
- Duratron™ T4203 PAI
- Duratron™ T5030 PAI
- Ketron™ 1000 PEEK
- Duratron™ U1000 PEI
- Kyron™ EPM-2204
- Kyron™ GC-100

Electrostatic dissipative materials

- Semitron™ ESd 520HR PAI (A)
- Semitron™ ESd 490HR PEEK (A)
- Semitron™ ESd HPV PEEK (D)
- Semitron™ ESd 480 PEEK (D)
- Semitron™ ESd 420V PEI (D)
- Semitron™ ESd 420 PEI (D)
- Semitron™ ESd 410C PEI (C)
- Semitron™ ESd 300 PET (D)
- Semitron™ ESd 225 POM (D)
- Semitron™ ESd POM CNT (D)
- Semitron™ ESd PEEK-CNT

A = Anti-static
D = Static dissipative
C = Conductive

Test Socket Materials

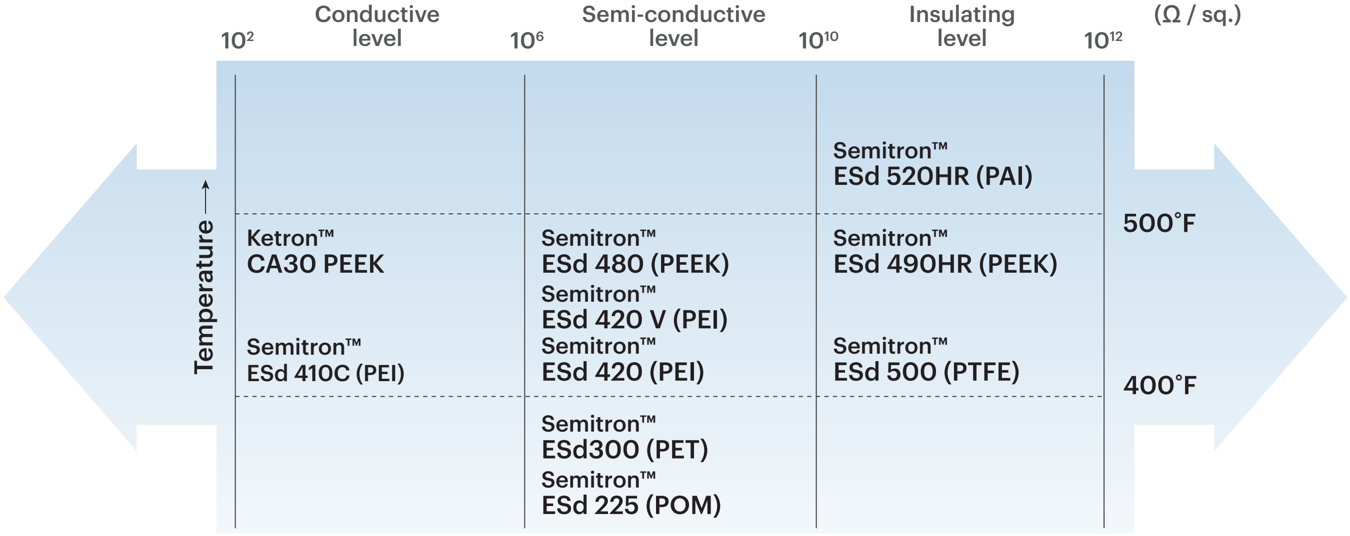


Semitron™ MDS-100

- ✓ Highest flexural modulus non-fiber-filled product
- ✓ Extremely low CLTE
- ✓ Available in thin cross sections ranging from 1mm to 6mm thick
- ✓ Very low moisture absorption
- ✓ Excellent machinability for fine features

ESd Performance

Anti-Static Properties



	Conductive level	Semi-conductive level	Insulating level
			Semitron™ ESd 520HR (PAI)
500˚F	Ketron™ CA30 PEEK Semitron™ ESd 410C (PEI)	Semitron™ ESd 480 (PEEK) Semitron™ ESd 420 V (PEI) Semitron™ ESd 420 (PEI)	Semitron™ ESd 490HR (PEEK) Semitron™ ESd 500 (PTFE)
400˚F		Semitron™ ESd300 (PET) Semitron™ ESd 225 (POM)	

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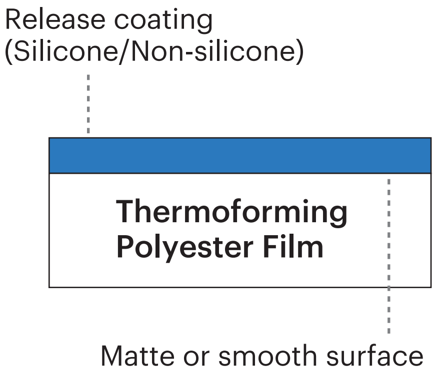
Packaging

05

DIAFOIL™ – Solution of Mold Release Film for WLP&PLP

In Development



Polyester film with the following key properties:

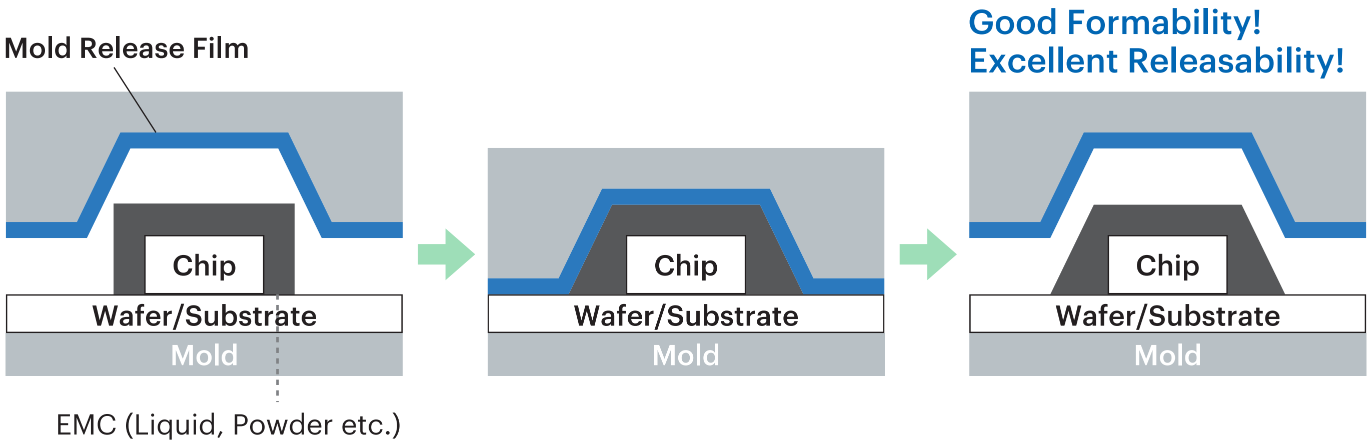
- ✓ Easy molding
- ✓ Releasability
- ✓ Eco-Friendly (PFAS FREE)

+

- ✓ Functional primer
(Antistatic, oligomer block etc.)

Application

■ **Using our film and coating technologies, we've developed new mold release films for compression mold targeted for WLP/PLP.**



Good Formability!
Excellent Releasability!

Features

■ **Our film exhibits superior formability at low temperatures compared to others.**

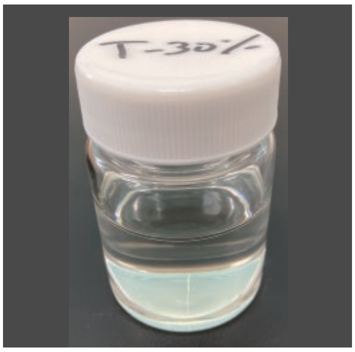
		Mitsubishi Chemical	Other Release Film - Competitor	ETFE Current product – competitor
Easy molding	High temperature	Good	Fair to Poor	Good
	Low temperature	Good	Poor	Good
Releasability		Excellent	Good	Good
Eco-friendly (PFAS FREE)		Good	Good	Poor

Packaging

06

Low-Dielectric Resin

In Development



- Top-class low-dielectric performance resin
- Soluble in toluene
- In combination with other materials such as m-PPE, lower total dielectric loss is achieved.

Key Characteristics

2 Types of low-dielectric resins

Type A : High heat resistance & high solubility in toluene
Type B : Extremely low dielectric loss

Item	Test Method	Unit	Type A	Type B
Dielectric constant (Dk) @10GHz	ASTM D2520 Reference	–	2.18	2.23
Dielectric loss (Df, tanδ) @10GHz	ASTM D2520 Reference	–	0.0002	0.0001
Water absorption	ISO 760 Reference	%	<0.01	<0.01
Vicat softening temp.	ISO 306 Reference	deg C	145	114
Solubility in Toluene	–	–	Excellent under room temp.	Possible by heating up solution

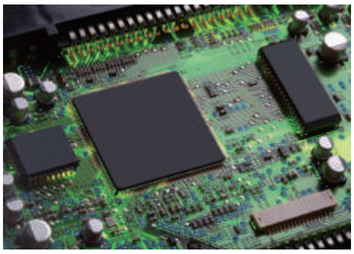
Combinations with Other Materials

Optimized solutions for combinations with m-PPE

We can provide the resin in the form of Toluene solution.
This solution is optimized for combination with m-PPE.

Applications

- CCL for high-speed communication
- Resin coated copper
- Interlayer insulation film
- Bonding film, etc.



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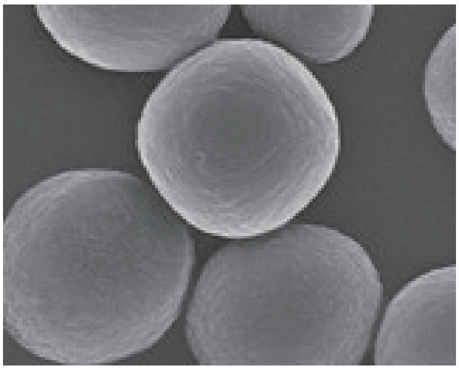
Packaging

07

Next-Gen Filler【Negative CTE】

Minimize Warpage, Maximize Possibilities

In Development



This <u>Advanced Filler for semiconductor applications</u> offers

- **Stable negative thermal expansion over wide range of temperatures**
- **Lightweight & spherical shape**
- **Excellent compatibility with various resins**
- **Low water absorption**

An innovative material solution for **thermal control & low-expansion resin composites.**

Filler Performance Data

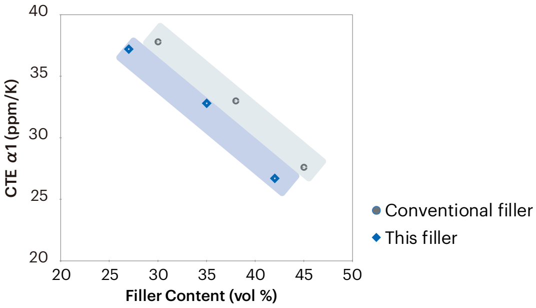
✓ Mitsubishi Chemical's liquid epoxy resin (jER™630) and an acid anhydride curing agent were compounded with up to 45 vol% filler using a three-roll mill.

✓ Compared to conventional fillers, <u>this filler delivered lower CTE in cured composites while maintaining a practical viscosity.</u>

【Formulation and Property Data】

Sample No.	Filler	Filler content (vol.%)	Viscosity (Pa･s)	CTE α1 (ppm/K)	Tg (℃)
1	This filler	27	0.7	37.2	154
2	This filler	35	2.2	32.8	150
3	This filler	42	6.1	26.7	155
4	Conventional filler	30	0.6	37.8	146
5	Conventional filler	38	1.5	33.0	148
6	Conventional filler	45	2.2	27.6	147

【CTE Comparison with Conventional Fillers】



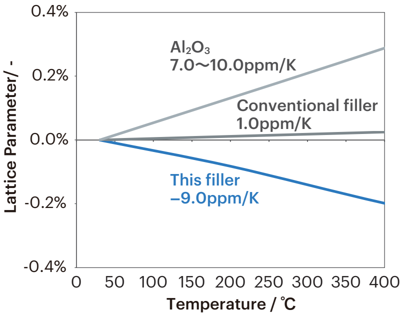
【Filler Characteristics】

Material	Conventional filler	This filler
CTE ppm/K	1	**−1～−10**
Temperature range	R.T. ~ 400℃	**R.T. ～400℃**
Density/gcm^{-3}	2.2	**1.9**
Shape	Spherical	**Spherical**

Product Features

- ✓ Consistent negative thermal expansion over a wide temperature range enables **reliable dimensional control** in semiconductor applications.
- ✓ Lightweight and spherical particle shape improves **flowability and dispersion in resin formulations.**
- ✓ **Excellent compatibility** with various resins allows for easy integration with epoxy, imide, and other thermosetting systems.
- ✓ Low water absorption enhances **moisture reliability** in harsh environments.
- ✓ Easy handling, similar to conventional fillers: allows for smooth replacement without major process change.

【CTE characteristics (temperature range)】



【Water absorption rate】

Filler	Weight change
Conventional filler	0.5%
This filler	0.7%

Condition: 85℃85%RH 24h

※All data were measured internally by Mitsubishi Chemical and are provided for reference only. These are not guaranteed values.

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Packaging

08

High Thermal Conductive BN Sheet

In Development

- Our **Ultra-High Thermal Conductive & Insulating BN Sheet** enables **thermal management** for power semiconductor modules.
- An ideal solution for **avoiding device degradation due to excessive heat** during prolonged use.

Key Performance Data

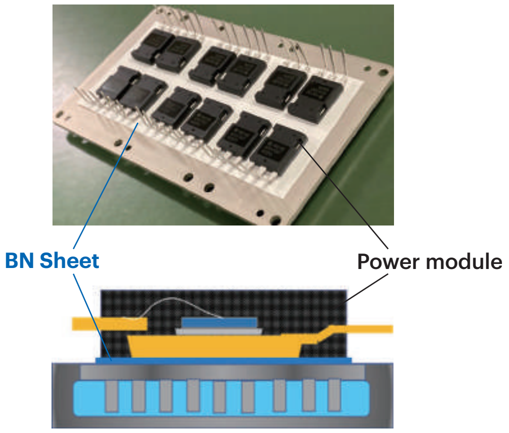
Item	DATA
Rth	70 % of Al_2O_3
Sheet thickness	150 μm
Thermal conductivity	15 W/mK
Glass transition temperature	162 ℃
PDIV AC	>5 kV
Shear strength	8.4 MPa@150℃

Features

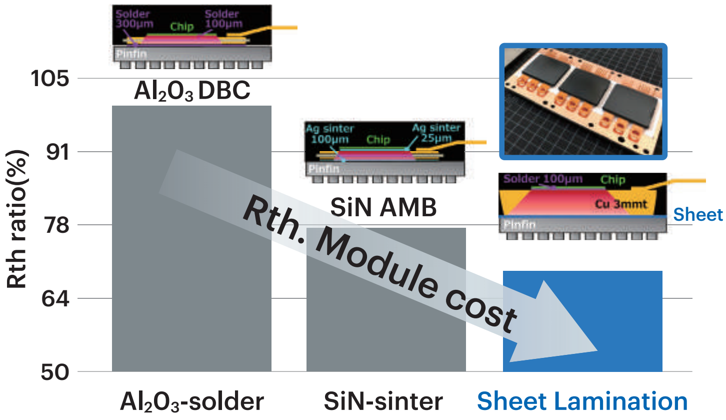
- ✓ **High thermal conductivity**
- ✓ **Insulation**
- ✓ **Total cost reduction (with less manufacturing process)**
- ✓ **Easy to cut**

Applications

Ideal Solution for Power Semiconductor Modules

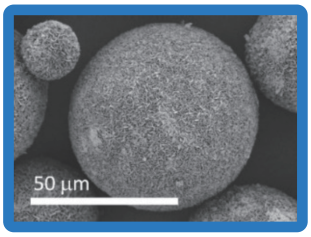


Laminate power module and heatsink by BN sheet

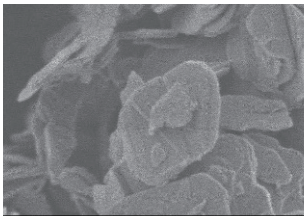


Reference

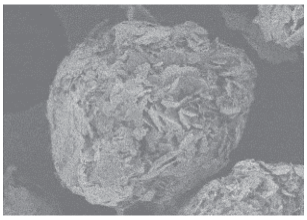
SEM observation images



BN filler



Others (A)



Others (B)

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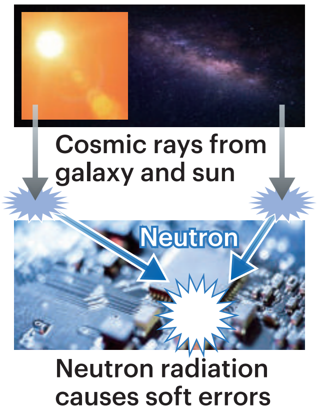
09

Thermal Neutron Shielding Coating

In Development

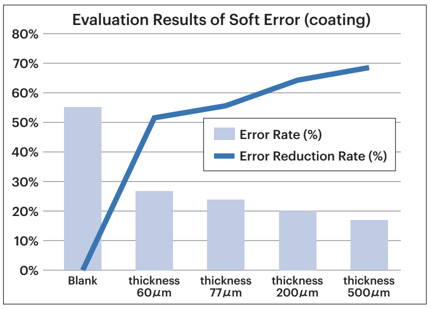


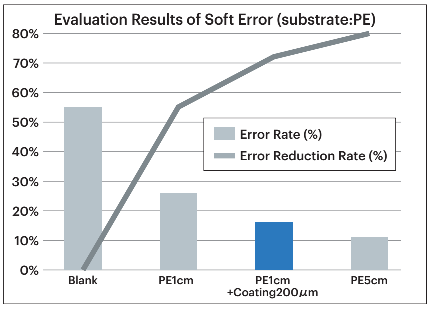
- We developed a water-based shielding coating with high concentrations of dispersed filler that mainly captures thermal neutrons.
- Its high shielding performance enables reduction in film and substrate thickness.

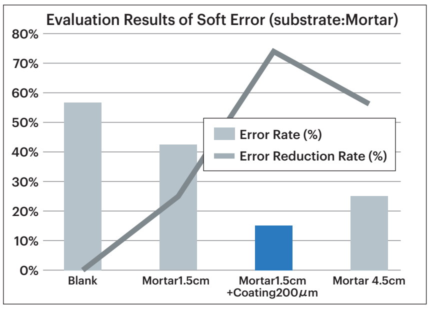
Performance Data of Coating

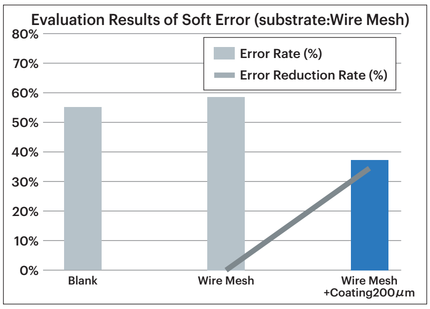
Evaluation Results of Soft Error

- ✓ The developed coating can reduce soft errors with a thinner film than conventional materials.
- ✓ When applied to a substrate (PE, mortar, wire mesh), the thickness of the substrate could be significantly reduced by applying only 200μm of coating to shield thermal neutrons.







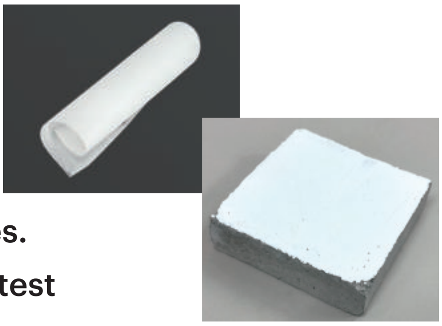


※Error Rate (%): per 1μC
※The soft error evaluation board was configured with 32MBit SRAM.

Product Features

Product Features

- ✓ 50μm coating sample on PET film is flexible and has no cracks.
- ✓ It can be applied to aluminum and mortar substrates.
  Aluminm substrate : No peeling in cellophane tape test



Services

10

台灣三菱化学

新竹總公司： 新竹縣湖口鄉光復路62號
高雄分公司： 高雄市大寮區華中路42號
台北聯絡處： 台北市中正區衡陽路51號10F-10
在台創新實驗室暨行銷服務處： 新竹縣竹北市台元街18號5F-1

- 半導體製造用高純度化學品之製造與販售
- 半導體製造用設備零件之精密洗淨
- 離子交換樹脂之製造與販售
- 平面顯示器製造用化學品之販售
- 顯示器材料（彩色光阻液）之販售
- 工程塑膠之販售

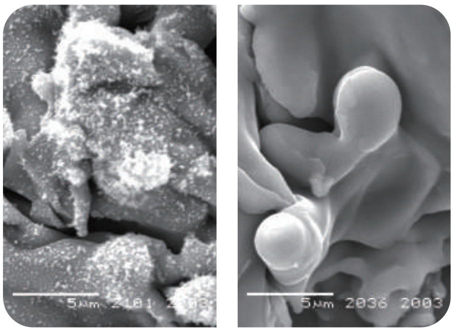
事業部門介紹

電子工業用高純度製程藥品

硫酸、氨水、Si蝕刻液、其他

半導體設備零組件清洗

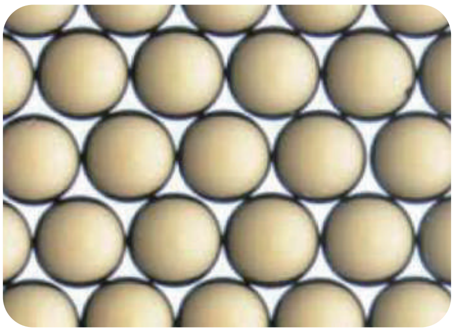
精密洗淨技術



洗淨前　洗淨後

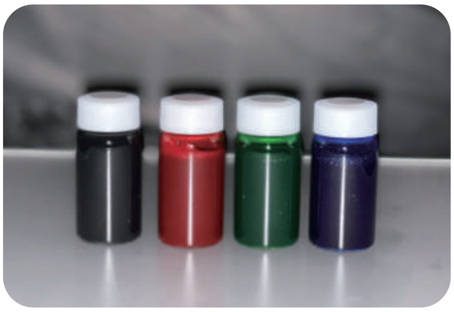
DIAION™ 離子交換樹脂

超純水製造, 中水回收, 廢水處理,
有價物回收, 電子級溶劑純化等



液晶顯示器用彩色光阻

平面顯示器產業
COLOR FILTER主要材料
彩色/黑色光阻



汽車連接器&消費性電子

PC & BIO PC & PBT & PPS

創新實驗室暨行銷服務處

選擇性蝕刻液
前驅物
後段製程材料