



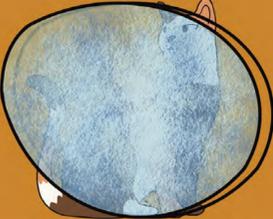
Anti-fogging property

Hydrophilic Anti-fog Coating Agent X-12-1373

Features and Benefits

- **Excellent anti-fog durability.**
(especially under high humidity conditions)
- **It has better water resistance than the conventional hydrophilic type.**

Anti-fog Mechanism

Hydrophilic type	Untreated	Caution
		
Maintains transparency by turning water vapor into a water film.	Water vapor becomes water droplets and gets fogging.	Water droplets freeze below 0°C

Applications

- Anti-fog treatment for glass and transparent resin (polycarbonate, etc.)

General Properties

Product name	X-12-1373
Active ingredient wt%	25
Solvent wt/wt	IPA: MEK= 3:1
Appearance at 25°C	Yellow liquid
Viscosity at 25°C mm ² /s	7
Standard curing conditios	120°C×30 min target film thickness 3 μm

(Not specified values)

Water Resistant Test Result

Anti-fog agent	X-12-1373 (Hydrophilic)	Other company's product A (Hydrophilic)	Untreated
Initial coating evaluation			
Initial anti-fog property	Good 	Good 	Bad 
Coating film evaluation after immersion in water for 1 hour			
Water resistant anti-fog property	Good 	Bad 	Bad 

Anti-fog test video





Anti-fogging property

Hygroscopic Anti-fog Coating Agent X-12-1372A

Features and Benefits

- Excellent water resistance and anti-fog durability.
- Room temperature moisture curing is possible.
- Since there is no water film, visibility is kept good. Also, it does not freeze.

Anti-fog Mechanism

Hygroscopic type	Untreated	Caution
Coating absorbs water vapor to maintain transparency.	Water vapor becomes water droplets and gets fogging.	Water droplets are generated when the moisture absorption limit is exceeded.

Applications

- Anti-fog treatment for glass and transparent resin (polycarbonate, etc.)

General Properties

Product name	X-12-1372A
Active ingredient wt%	25
Solvent wt/wt	IPA: MEDG= 3:1
Appearance at 25°C	Pale yellow liquid
Viscosity at 25°C mm ² /s	40
Standard curing conditios	Add 1wt% of curing catalyst D-25, 120°C×30 minutes or 23±2°C/50±5%RH×7 days Target film thickness 2µm

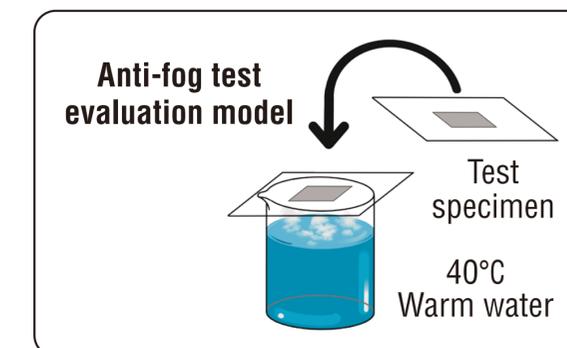
(Not specified values)

Water Resistant Test Result

- Anti-fogging evaluation method: Exposed to water vapor at 40°C in a closed system, Check how many seconds it will start to fog
- Substrate: Polycarbonate

Anti-fog agent	40°C water vapor anti-fogging time			
	Initial	40°C warm water immersion time		
		24h	100h	240h
X-12-1372A (Hygroscopic)	30s	150s	160s	130s
Other company's product A (Hydrophilic)	∞	0s		

(Not specified values)





Adhesion

Amino Acid Ester Type Silane Coupling Agent X-88-475

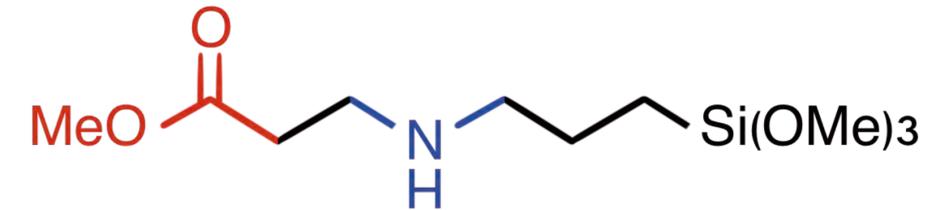
Features and Benefits

- A silane coupling agent with an amino acid ester structure.
- The surface treatment of glass fiber improves adhesion to epoxy resin.
- Improves adhesion and water resistance when used as a terminal modifier for urethane resins.
- Aqueous solutions are neutral and highly stable. (pH 7-8)

General Properties

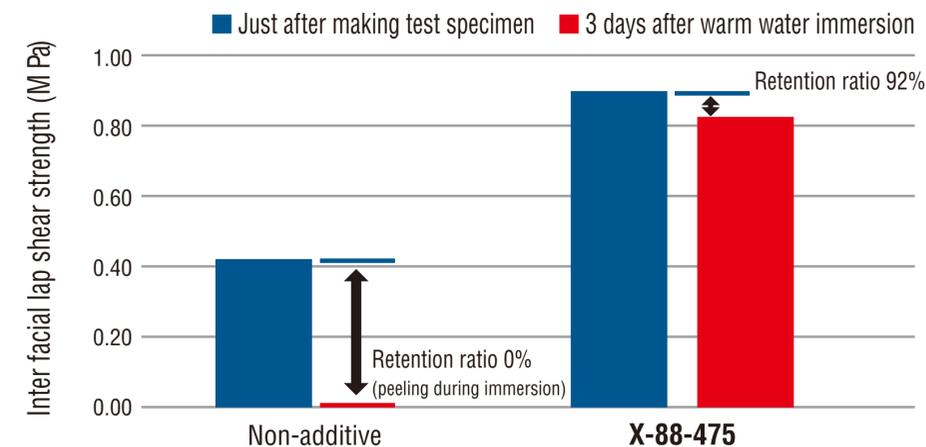
Product name	X-88-475
Applicable solvent system	Organic solvent system, water system
Applicable resin	Epoxy, acrylic, polycarbonate, urethane, ABS, EPDM, EPM, PBT, PET, urethanerubber, nylon, nitrile rubber, neoprenerubber, phenol, furan, polyimide, polyethylene, polyvinyl chloride, polysulfide, polystyrene, polypropylene, melamine
Solvent system	Solvent-free
Usage	Surface treatment of glass cloth and filler, Additives
Organic functional group	Amino group, Ester group

Chemical Structure



Improving the Adhesion and Water Resistance of Urethane Adhesives

- 0.2wt% mixture as a terminal modifier for urethane adhesives
- Substrate: glass

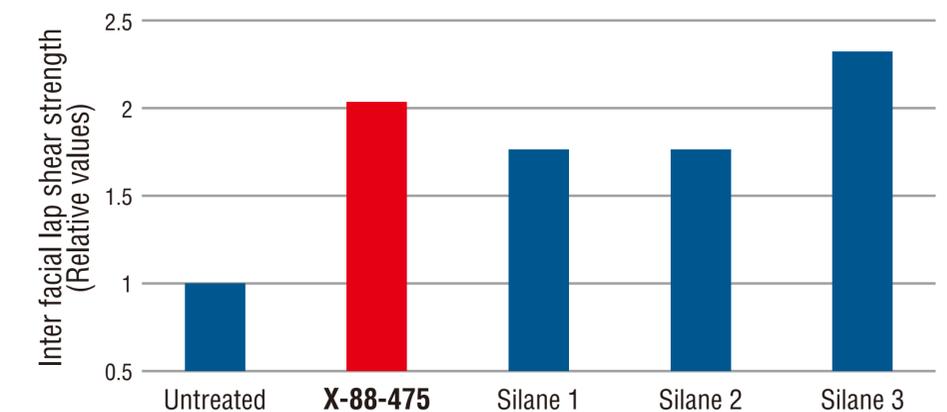


If it is not added, it will peel off during immersion in hot water. Addition of X-88-475 improves adhesion and water resistance.

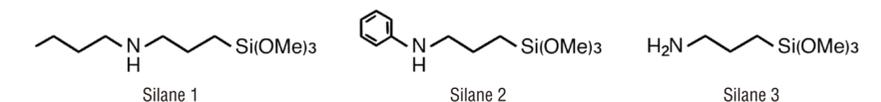
*Retention ratio = [3 days immersed in warm water] / [after test piece preparation] x 100.

Improved Adhesion between Glass and Epoxy resin

- Treat glass fiber with 1wt% aqueous solution
- Measured by the microdroplet method



X-88-475 has better coupling performance than other secondary aminosilanes.





High Hardness, Crack Resistance, Anti-fouling Coating Agents X-88-2003A

Features and Benefits

- This product achieves both high hardness and crack resistance.
- Excellent crack resistance in high temperature environments
- It has excellent water repellency, water sliding property, and magic marker stain resistance.
- Rapid cure
- One-component type

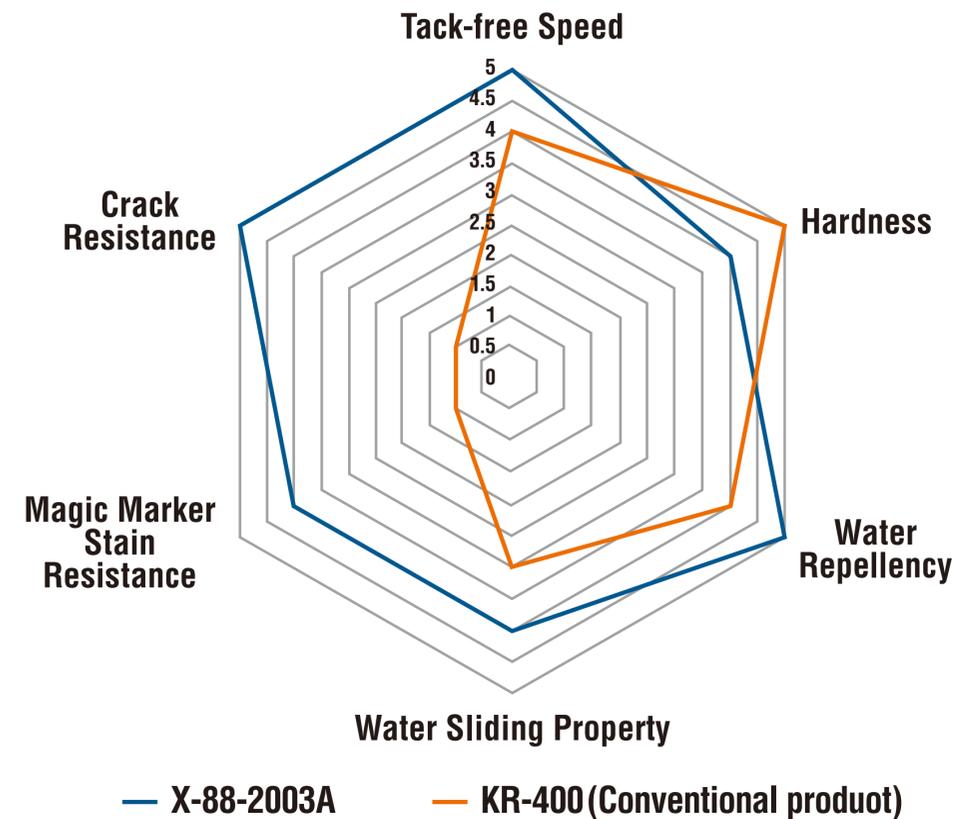
General Properties

Product name		X-88-2003A	KR-400
Tack-free min		<30	30-60
Pencil hardness		4H	8H
Water contact angle*1 (2μL)°		107	92
Water fall angle*2 (20μL)°		27	32
Crack resistance	Room temperature	Good	Good
	150°C×2h After heat resistance test	Good	Poor
Magic marker stain resistance		Good	Poor

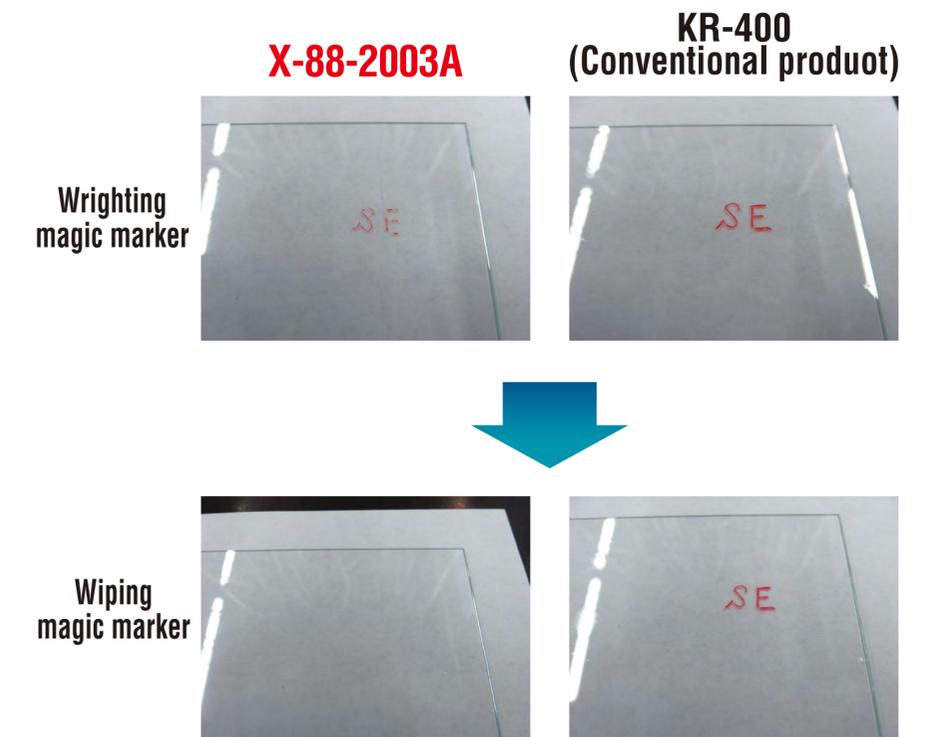
*1 Higher value means good performance.
*2 Lower value means good performance.

(Not specified values)

Comparison with General-purpose Silicone Oligomer



Magic Stain Resistance



*Shin-Etsu Chemical is also developing a similar de-ethanol type product. If you are interested, please contact us.



Solvent Resistance



Water Repellency



Electrical Insulation



High Hardness, High Strength

Room Temperature Curing Highly Film Formable Silicone Oligomer X-48-2316

Features and Benefits

- Solvent-free, low-viscosity, catalyst-containing, one-component type
- It has a tack-free time of less than 10 minutes at room temperature, and forms a cured film with excellent solvent resistance, water repellency, and electrical insulation after complete curing.
- It forms cured films with high hardness and high strength.

General Properties

Product name	X-48-2316
Type	Methyl
Appearance	Pale yellow to yellow liquid
Viscosity at 25°C mPa·s	100-200
Solvent	Non-containing
Cured film property	
Hardness Durometer A	90
Tensile strength MPa	5
Volume resistivity TΩ·cm	2 - 3
Dielectric breakdown strength kV/mm	>20
Elongation at break %	2 - 30

(Not specified values)

Applications

- Water repellent coating
- Insulation coating
- Conformal coating

Cured Film Property

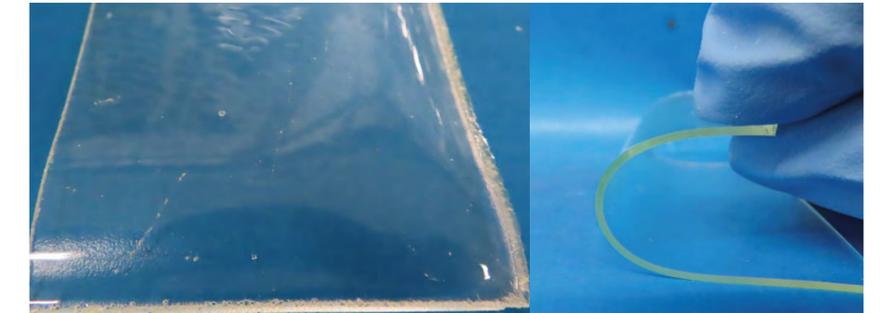
(Thickness 10 μm, Curing for 1 week at room temperature)

Product name	X-48-2316
Tack-free min	8
Acetone rubbing test times	>50
Water contact angle (2μL)°	103
Glass/Epoxy adhesion*1	100/100
Steel plate adhesion*2	100/100
Pencil hardness	4B
Heat resistance (250°C ×1h)	No change
Flame retardancy*3	V-0 Equivalent

*1 Substrate: FR-4 *2 Substrate: Zinc phosphate treated steel plate (Not specified values)

*3 In-house simple evaluation results based on flame retardancy UL94 standards

Appearance of Cured Film (Film thickness 2mm)



Various Durability Test Results

- Heat resistant test: 150°C×500h
- Moist heat test: 85°C/85%RH×100h
- Long-term migration test: 100V/60°C/90%RH/1,000h



No change in appearance, electrical characteristics, etc.



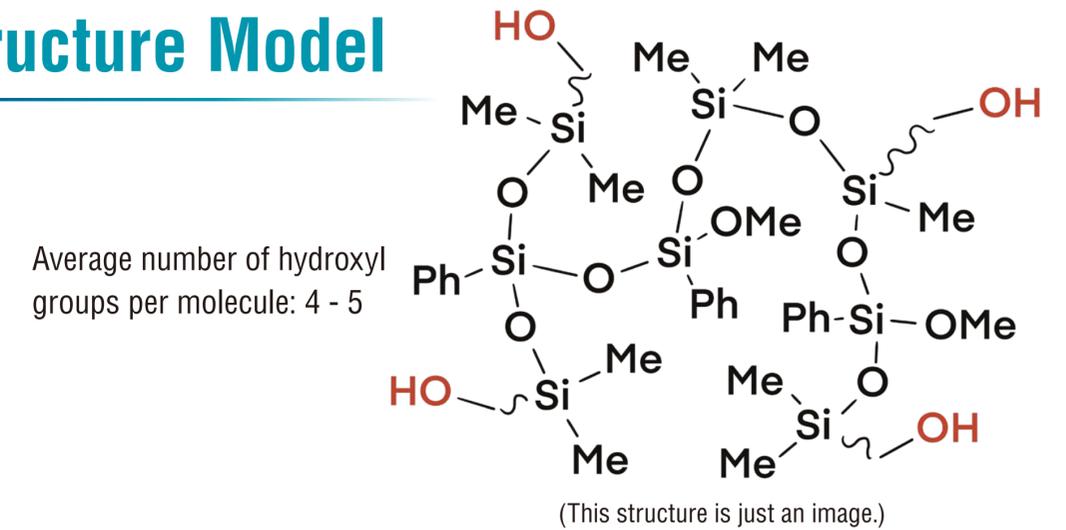
Cold Blend Resin Modifier

OH Group Containing Silicone Oligomer X-48-1900 Series

Features and Benefits

- A silicone oligomer containing reactive hydroxyl groups.
- It can be used as a resin modifier for polyurethane, polyester and melamine resins.
- It has excellent compatibility with resins and can increase the amount of silicone modification in resins.
- Resin modification is possible by simply mixing at room temperature (cold blending), and large-scale equipment is not required.
- Imparts flexibility, antifouling properties, and weather resistance to the coating film.

Structure Model



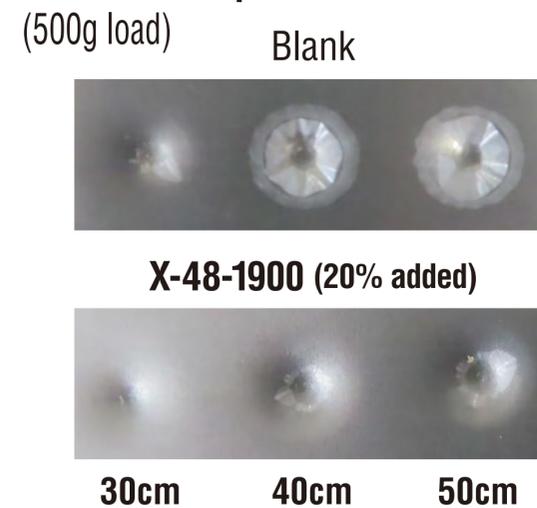
General Properties

Product name	X-48-1900	X-48-1901
Usage	Additive	Additive
Active ingredient wt%	100	100
Appearance	Colorless transparent liquid	Colorless transparent liquid
Viscosity at 25°C mm ² /s	600	500
OH Value KOH mg/g	50-150	50-150
Water solubility (50% aqueous solution appearance)	-(Precipitation)	+(Dispersion)

(Not specified values)

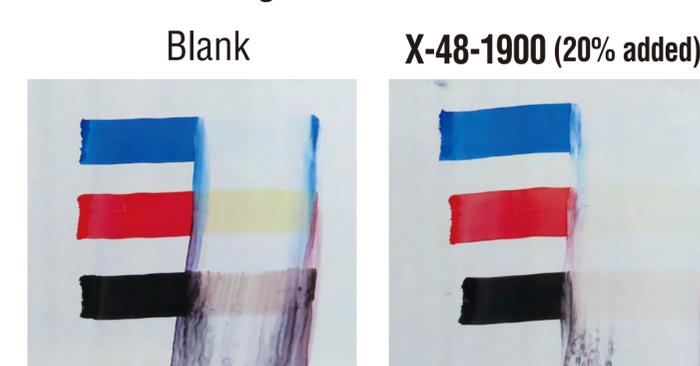
Modification Example by Cold Blending to Two-component Polyurethane Resin

■ DuPont impact resistance test (500g load)



Film thickness: 30 μm, Substrate: zinc phosphate treated steel plate

■ Anti Fouling Test



Film thickness: 30 μm, Substrate: Polyester coated steel plate
 Lines were drawn with an organic solvent marker, Mackee (manufactured by Zebra Co., Ltd.), left for 3 hours, and then wiped off with ethanol:toluene (1:1) on the right side.

■ Weather Resistance Test (gloss retention rate)

Parameter	Blank	X-48-1900 (20% added)
Initial	100%	100%
SUV After 30 cycle	32%	57%

(Not specified values)

*Equivalent to 1 year for 10 cycles

Thickness: 30 μm, Substrate: Polyester coated steel plate
 *1 cycle: UV (90mW) irradiation for 4 hours
 → 4 hours of darkness → 4 hours of condensation



Vinyl Silane Coupling Agent for Low Dielectric Resins KBM-1063

Features and Benefits

- A silane coupling agent with a vinyl group that is compatible with polyethylene, polypropylene, etc.
- Adhesion to PPE resin is improved by surface treatment of glass fiber compared to general-purpose methacrylsilane. In addition, it is possible to reduce the dielectric of the glass cloth.

Chemical Structure



Aqueous Solution can be made

[Aqueous solution composition]
 KBM-1063 : 0.5g
 Acetic acid water : 99.5g

Aqueous solution appearance



General Properties

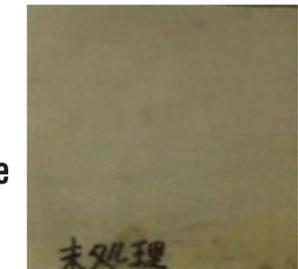
Product name	KBM-1063
Applicable solvent system	Organic solvent system, water system
Applicable resin	PPE, Maleimide, EPDM, EPM, Diallyl phthalate, unsaturated polyester, polyethylene, polypropylene
Solvent system	Solvent-free
Usage	Surface treatment of glass cloth and fillers, Additive
Organic functional group	Vinyl groups
Appearance	Colorless transparent liquid
Viscosity	1.2mm ² /s

(Not specified values)

Glass Cloth Treatment Test Result

Item	Untreated	KBM-503	KBM-1063
Structure of treatment agents	—		
Glass cloth tensile strength relative values	100	200	200
Dielectric dissipation factor 10GHz relative values	100	95	85
Cured prepreg			
Solder heat resistance test *1	Poor	Good	Good
Alkali immersion test *2	Poor	Slightly poor	Good

Appearance : After solder heat resistance test



- : Totally whitening



+ : No change

Appearance : After alkali immersion test



- : Totally whitening



+ : Edge parts whitening

*1 Conditions: After immersion in boiling water for 2 hours, solder float at 260°C for 30 seconds Prepreg: PPE resin composition + (silane treatment) E glass cloth +: No change, -: Totally whitening

*2 Conditions: 1 mol/L (molar concentration) NaOH aqueous solution immersion (40°C x 24 hours) Prepreg: PPE resin composition + (silane treatment) E glass cloth +: Whitening only at the edges, ±: Many parts whitening, -: Totally whitening

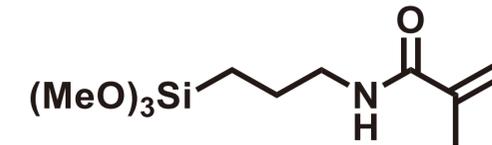


Methacrylamide Silane Coupling Agent for Low Dielectric Resins X-12-1370

Features and Benefits

- A silane coupling agent with a methacrylamide structure.
- Adhesion to maleimide resin is improved by surface treatment of glass fiber compared to general-purpose methacrylsilane. In addition, it has good aqueous solution stability, and it is possible to reduce the dielectric of the glass cloth by surface treatment.

Chemical Structure



Aqueous Solution can be made

Good stability

[Aqueous solution composition]

X-12-1370: 0.5g

Acetic acid water: 99.5g

Aqueous solution appearance



General Properties

Product name	X-12-1370
Applicable solvent system	Organic solvent system, water system
Applicable resin	PPE, maleimide, polyimide, acrylic, polycarbonate, urethane, ABS, EPDM, EPM, diallyl phthalate, unsaturated polyester, polyethylene, polystyrene, polypropylene
Solvent system	Solvent-free
Usage	Surface treatment of glass cloth and fillers, additives
Organic functional group	Methacrylamide group
Appearance	Colorless to pale yellow transparent liquid
Viscosity	27mm ² /s

(Not specified values)

Glass Cloth Treatment Test Result

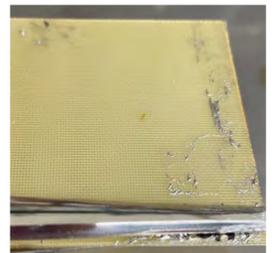
Item	Untreated	KBM-503	X-12-1370
Structure of treatment agents	—	<chem>CC(=O)OCCCO[Si](OC)(OC)OC</chem>	<chem>CC(=O)NCCCO[Si](OC)(OC)OC</chem>
Glass cloth tensile strength relative values	100	180	200
Dielectric dissipation factor 10GHz relative values	100	95	75
Cured prepreg			
Solder heat resistance test *1	Poor	Good	Good
Alkali immersion test *2	Poor	Slightly poor	Good

Appearance: After solder heat resistance test



Swelling

-: Peeling



+: No peeling

Appearance: After alkali immersion test



-: Many whitening



+: Few whitening

*1 Test conditions: After immersion in boiling water for 2 hours, solder float at 260°C for 30 seconds Prepreg: Maleimide resin composition + (silane treatment) low dielectric glass cloth +: No peeling -: Full peeling

*2 Test conditions: 1 mol/L (molar concentration) NaOH aqueous solution immersion (40°C x 24 hours) Prepreg: maleimide resin composition + (silane treatment) low dielectric glass cloth +: Little whitening, ±: Moderate whitening, -: A lot of whitening