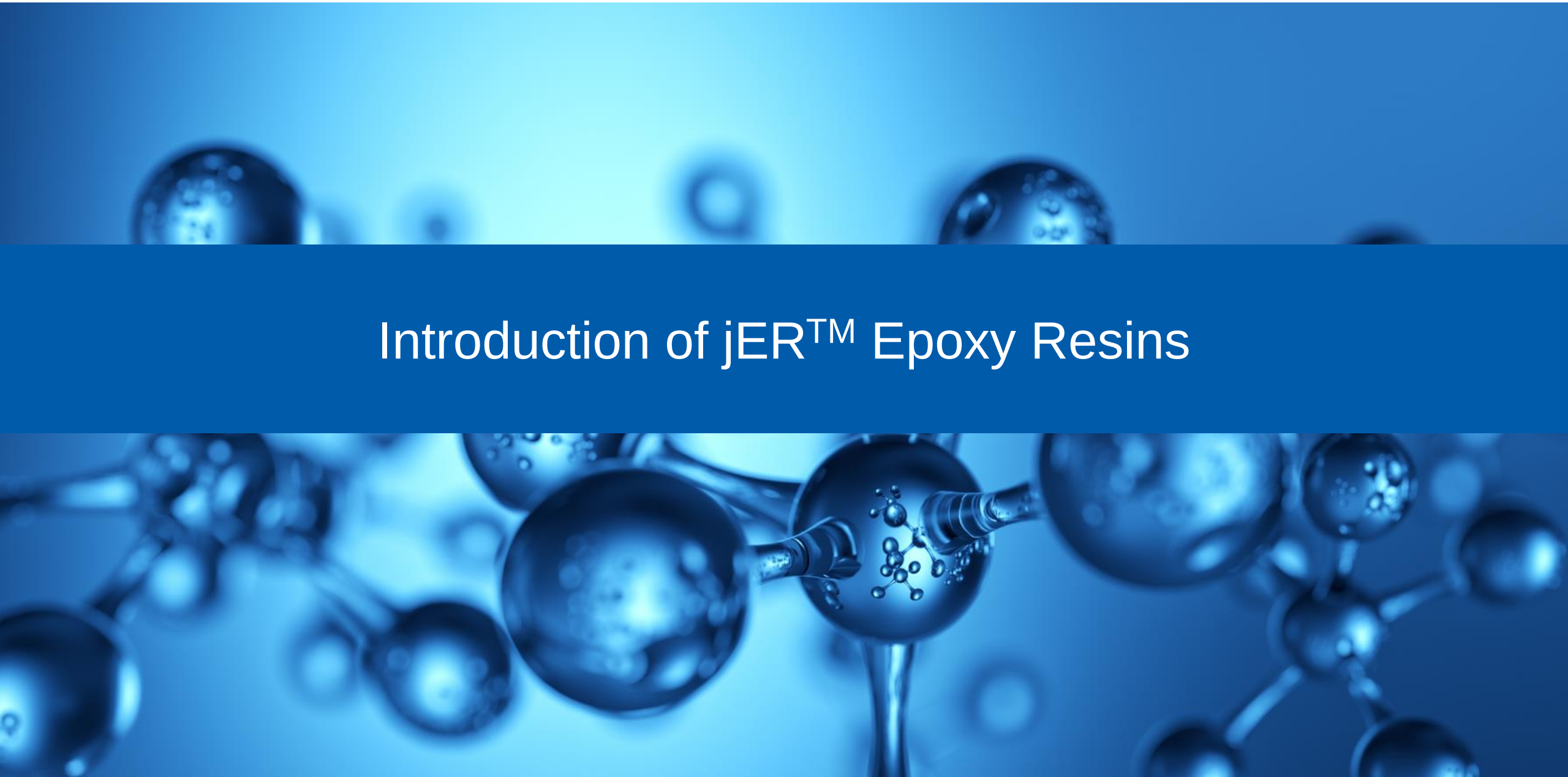
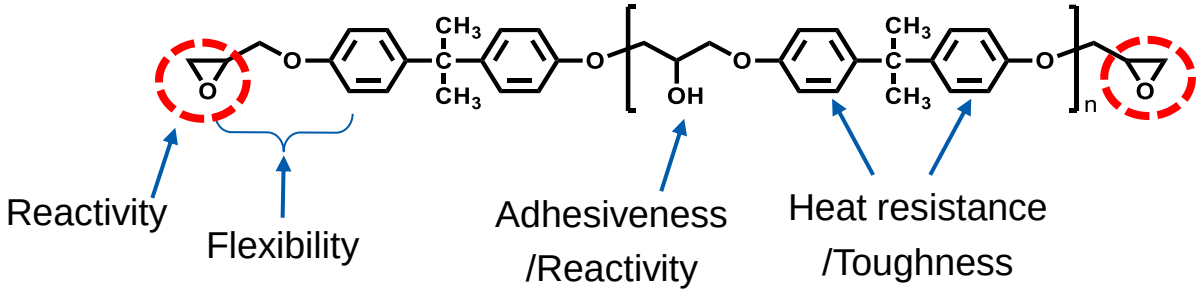
MITSUBISHI CHEMICAL GROUP

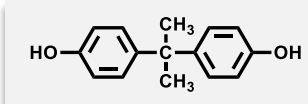


Introduction of jER™ Epoxy Resins

Epoxy Resin | What is it?

Epoxy Resin | is Compounds having multiple epoxy groups





Epoxy Resin | Features

Highly adhesive to metal, porcelain, concrete

High mechanical strength

Excellent insulation property

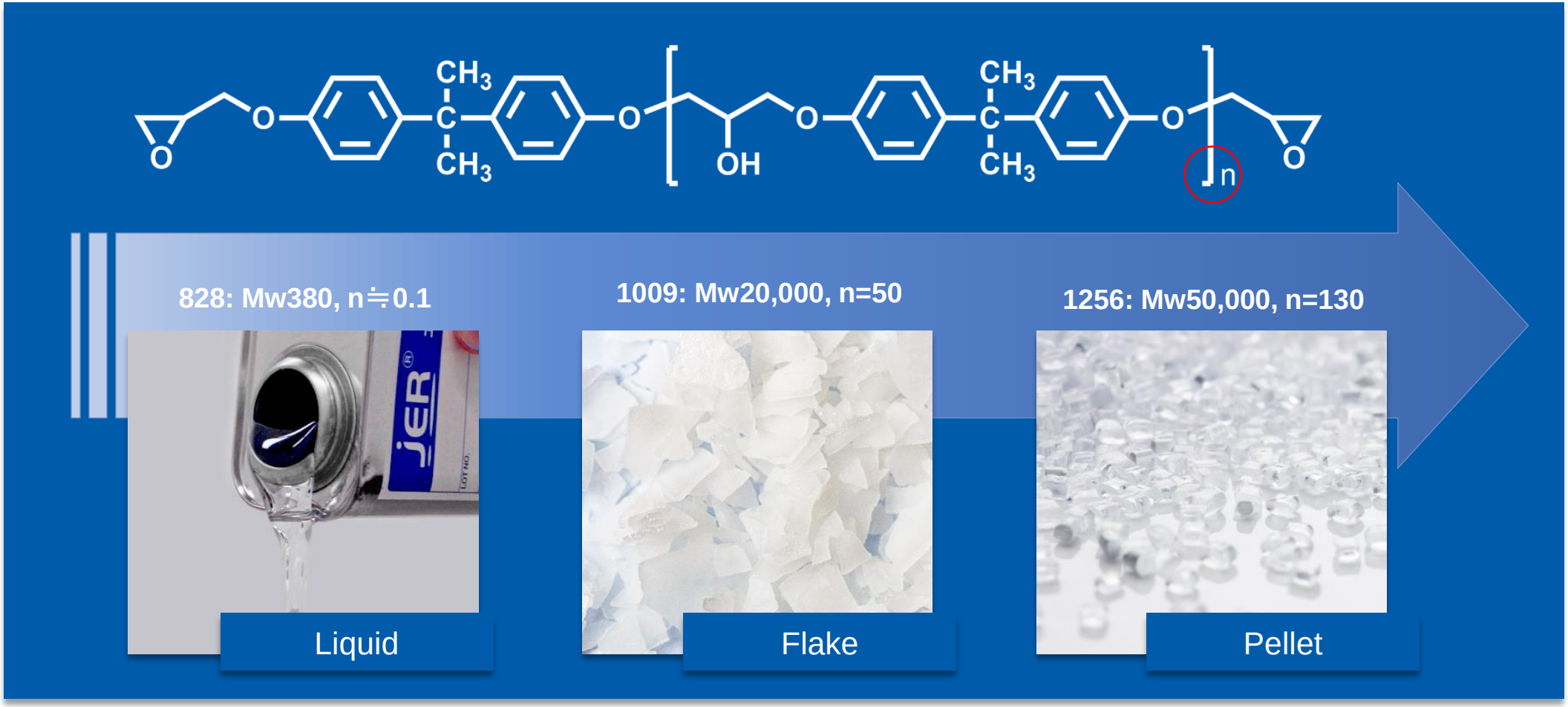
High heat resistance

High chemical resistance

High water resistance

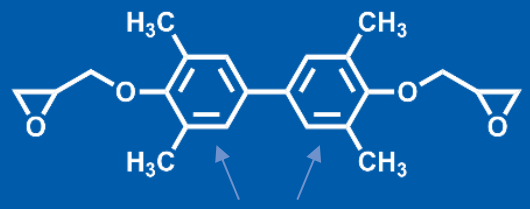
Epoxy Resin | Product Appearance

Appearance varies depending on Mw(Molecular weight)/structure



Epoxy Resin | Product Appearance

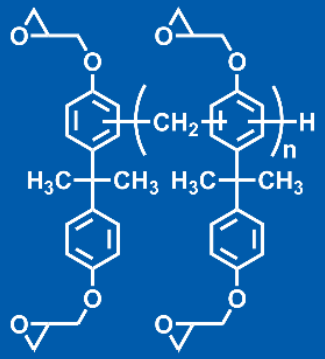
Appearance varies depending on Mw(Molecular weight)/structure



Planar Structure

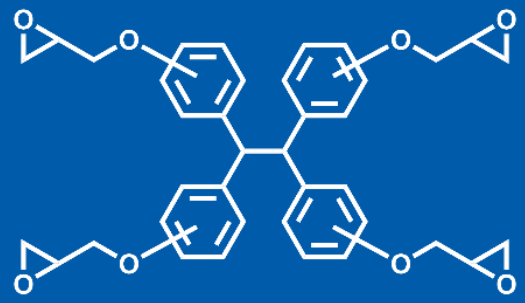
YX4000

Yellowish Crystal



157S70

Marble

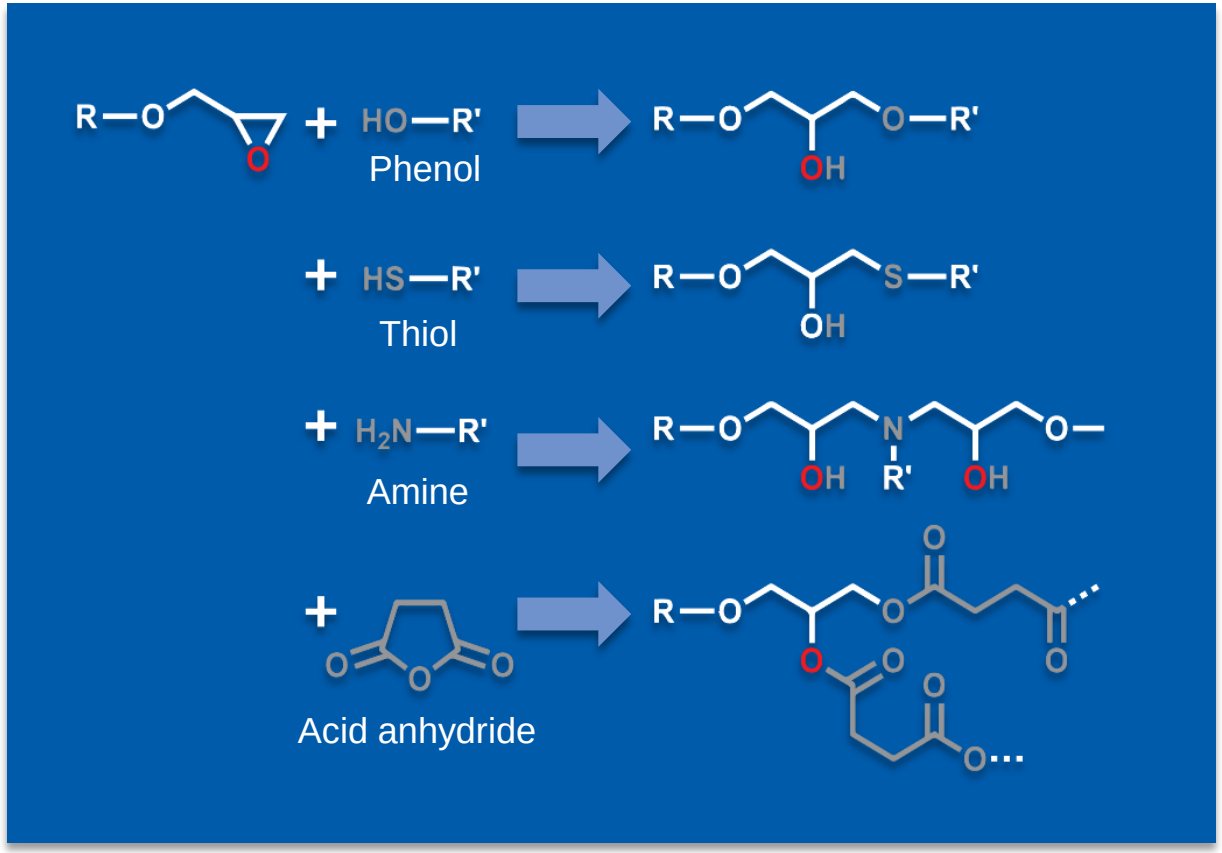


1031S

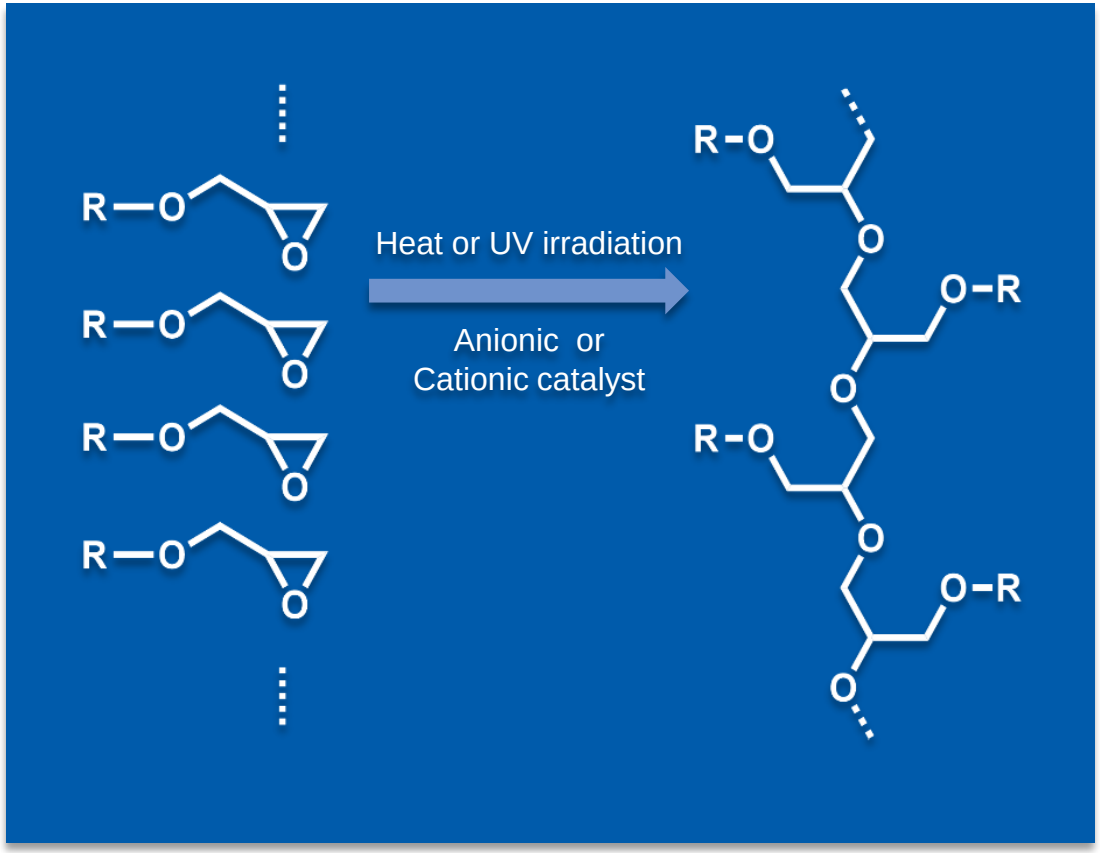
Colored Flake

Epoxy Resin | Typical Reactions

Reaction with Representative Hardeners



Self Polymerization



Epoxy Resins | Selection of Hardeners

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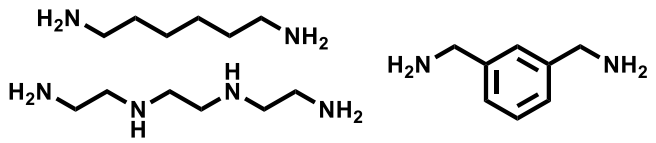
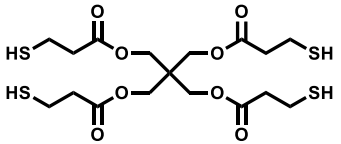
Appropriate choice of hardener for a desired curing temperature

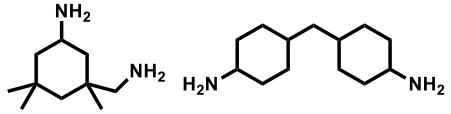
Aliphatic Amine



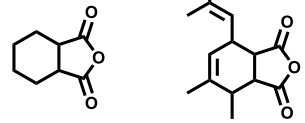
Thiol



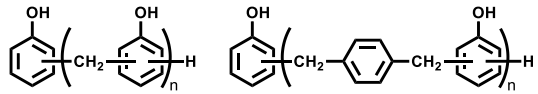
Alicyclic Amine



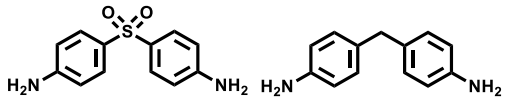
Acid Anhydride



Phenol



Aromatic Amine



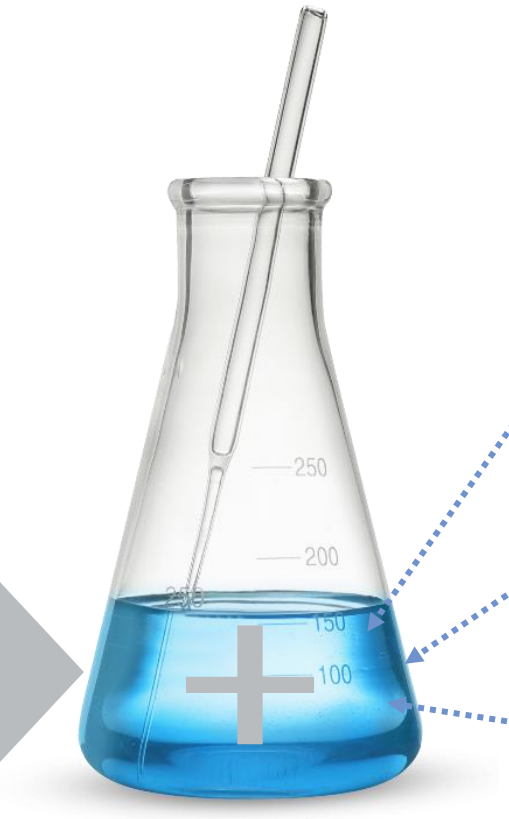
＞10℃	＞40℃	＞80℃	＞100℃	＞150℃	＞180℃
Thiol	Aliphatic Amine	Alicyclic Amine		Aromatic Amine Acid Anhydride	Phenol

Epoxy Resin | General ways to use epoxy

Epoxy resin's 3D cross-linked versatility, high strength, and excellent adhesion to variety of surfaces makes it an ideal choice in so many applications and combinations.

Type of Epoxy

- Bisphenol
- Novolac
- Aralkyl
- Amine



Type of Hardeners

- Phenol Novolac
- Thiol
- Amine
- Acid anhydride
- Dicyandiamide

Type of Catalyst

- Phosphine
- Amine
- Imidazole
- Photo-/Thermo-Cationic /Anionic

Type of Fillers

- Silica
- Alumina
- Boron Nitride
- Mg(OH)2

Applications of Epoxy Resin

Civil Construction

- Water pipelining
- Flooring material
- Bridge pier repair materials

Paints & Coatings

- Beverage cans
- Automotive primer coating
- Marine Paint
- Anti-corrosion/rust
- Powder Paint

Electric & Electronics

- Semiconductor encapsulant
- Printed wiring board
- Solder resist
- Underfill
- Die attach film
- Insulation Mold

Composite Materials

- FRP(CFRP/GFRP)
- Automobiles, Aircraft,
- Sports Equipment

Adhesives

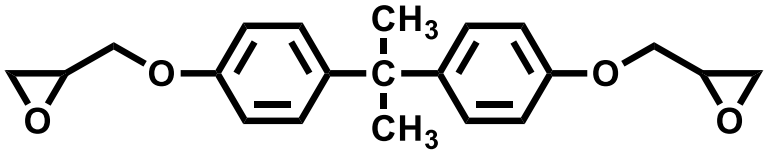
- Structural adhesives
  (Automobiles, aircraft, etc.)
- Adhesives for household use

Additives

- Stabilizer for vinyl chloride
- Resin flame retardant
- Toner

Bisphenol A (BisA) liquid type

- 828 is widely used as most basic epoxy resin
- YL980 is suitable for electronic application where low Cl needed



828/YL980

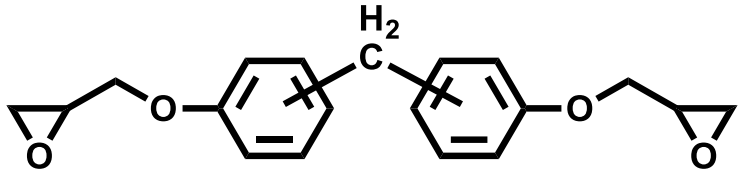
Grade	WPE (g/eq)	Viscosity (P)	Total-Cl (ppm)	Comments
828	186	135	3,100	Standard BisA
YL980	186	135	300	Low-Cl

<Applications>

◆ YL980: Liquid underfill/adhesive for semiconductor package

Bisphenol F (BisF) liquid type

- 807 is widely used as common low viscosity epoxy resin
- YL983/1750 are suitable for electronic application where low viscosity, low Cl needed



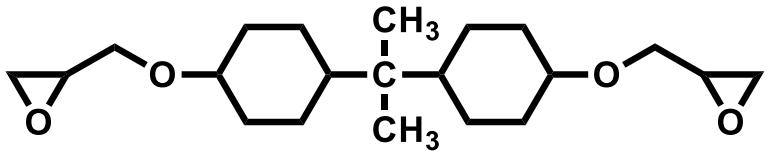
Grade	WPE (g/eq)	Viscosity (P)	Total-Cl (ppm)	Comments
807	169	36	2,100	Standard BisF
YL983U	169	35	300	Low-Cl
1750	157	13	800	Lower viscosity

<Applications>

◆ Liquid underfill, adhesive for semiconductor package

Hydrogenated BisA-type

- Excellent transparency even after full-curing
- Hydrogenation of aromatic rings can improve photo-curability



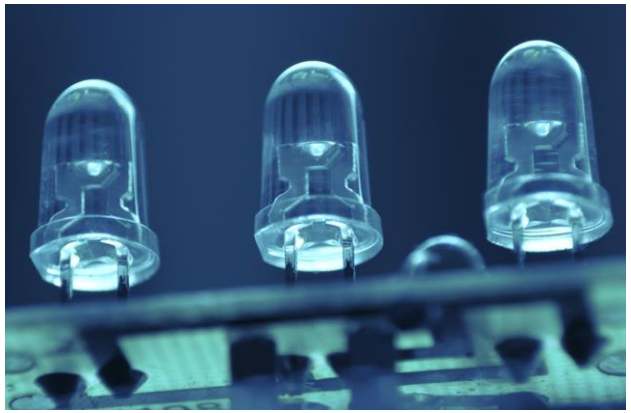
YX8000/YX8000D

Grade	WPE (g/eq)	Viscosity (P)	Total-Cl (ppm)	Appearance	Comments
YX8000	201	19	1,500	Liquid	
YX8000D	185	8	900	Liquid	Low-Cl
YX8040	1,000	3*	500	Solid	Low-Cl

* at 150℃

<Applications>

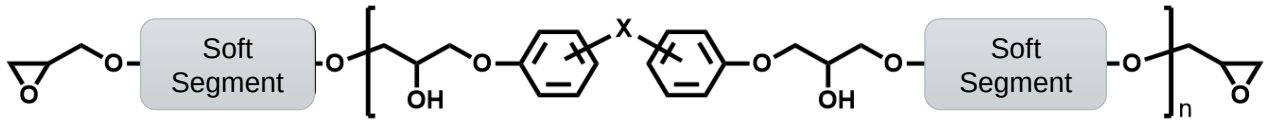
- LED/OLED encapsulant, LED reflector
- Photocure process (UV/LED)
- Adhesives for optical devices, electro-optic assemblies, and laser components



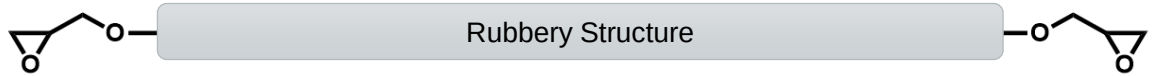
Flexible and Rubbery type

- Keep flexibility even after full-curing
- YX7100s are tough & stretchable, YX7400N features rebound resilience

YX7105/YX7110



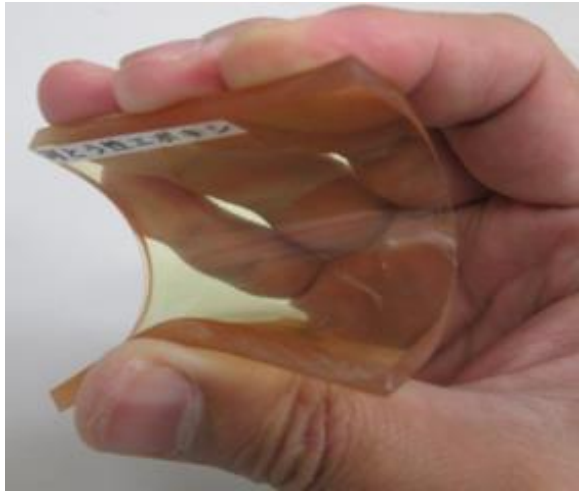
YX7400N



Grade	WPE (g/eq)	Viscosity (P)	Total-Cl (ppm)	Comments
YX7105	485	62 at 50℃	500ppm	Standard
YX7110	1,100	2,670 at 50℃	500ppm	More flexible and stretchable
YX7400N	440	1.9 at 25℃	1,000ppm	Rubbery elastic

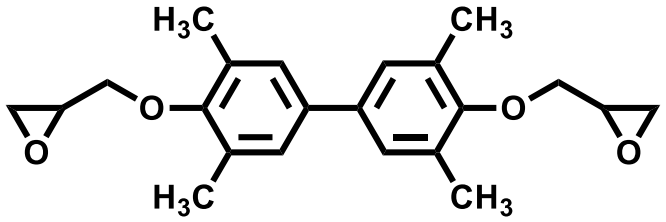
<Applications>

- Additives for stress relaxation (to avoid cracking, warpage)
- Impact modifier for brittle materials
- Base film/sheet for wearable devices



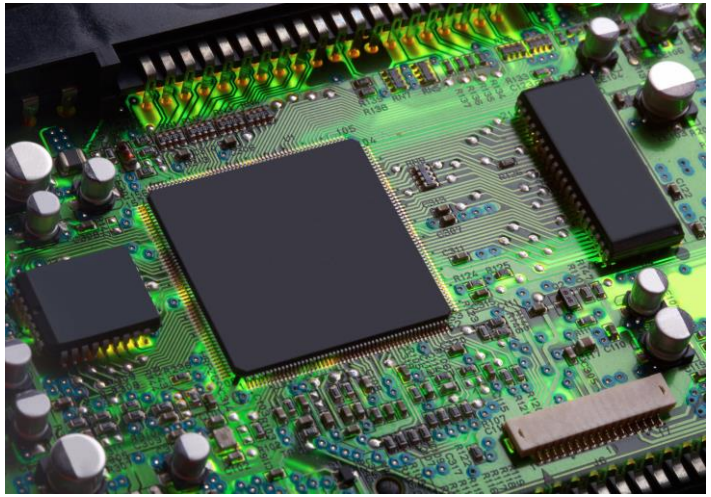
Crystalline type

- YX4000 is widely used for thin-package EMC as de-facto standard
- Suitable for solid compounding, but not stable in varnish



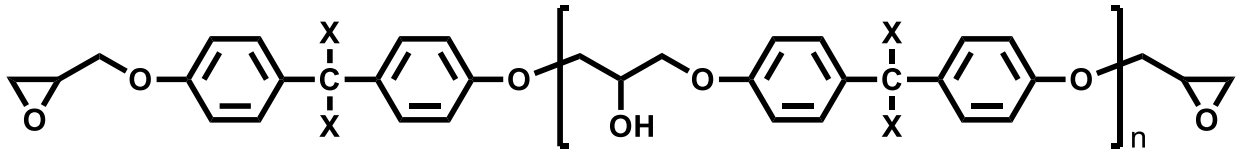
Grade	WPE (g/eq)	m.p. (℃)	Total-Cl (ppm)	Comments
YX4000	185	105	1,000	Standard for EMC
YX4000H	185	105	400	Low-CL type

<Applications>
◆ Electronic application (EMC, solder resist, PCB, etc.)
◆ Powder paint/coating (taking advantage of crystallinity)



High molecular weight type

- Fully cured epoxy resins are generally very hard but brittle
- Addition of polymer epoxy resin gives toughness and film/sheet formability

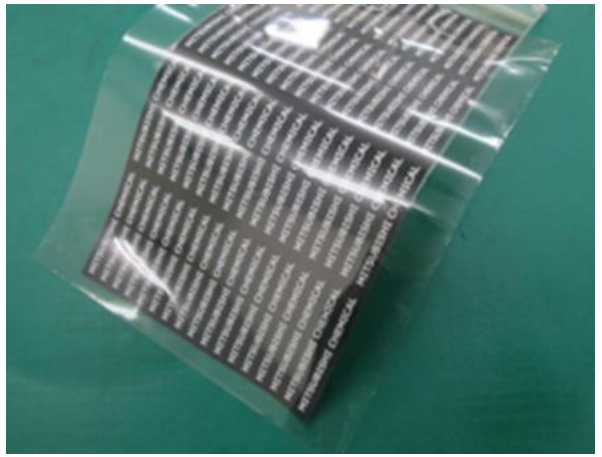


BisA-type: X=CH_3 BisF-type: X=H

Grade	Structure	WPE (g/eq)	Mw	Appearance	Comments
1256	BisA	7,800	51,000	Pellet	Standard
4250	BisA : BisF = 50 : 50	8,200	59,000	Pellet	Flexible

<Applications>

- ◆ Paint & Coating: Additives to improve paint-ability/coat-ability
- ◆ CFRP: Additives to give toughness/flexibility
- ◆ Modifier for thermoplastics (Hydrolysis resistance, adhesive etc.)



General (Liquid type)

Grade	Sales specification			Remarks
	WPE (g/eq)	Color / Gardner (-)	Viscosity at 25℃ (P)	
827	180 ～ 190	0.6 max	90 ～ 110	Bisphenol A (BisA)
828	184 ～ 194	0.6 max	120 ～ 150	BisA
828EL	184 ～ 194	0.6 max	120 ～ 150	BisA, Low chlorine content (Sap. Cl: 240ppm*)
828US	184 ～ 194	0.4 max	120 ～ 150	BisA, Low chlorine content (Sap. Cl: 50ppm*)
834	230 ～ 270	0.6 max (1)	P ～ U (2)	BisA, Semi-solid
806	160 ～ 170	3 max	15 ～ 25	Bisphenol F (BisF)
807	160 ～ 175	3 max	30 ～ 45	BisF

General (Solid type)

Grade	Sales specification			Typical value	Remarks
	WPE (g/eq)	Color / Gardner (1) (-)	Viscosity at 25℃ / Gardner-Holdt (1) (-)	Softening Point /(2) (℃)	
1003F	700 ～ 800	0.6 max	P ～ T	96	Bisphenol A (BisA)
1004FS	770 ～ 850	0.6 max	Q ～ V	100	BisA
1004F	875 ～ 975	0.6 max	T ～ W	103	BisA
1005F	950 ～ 1,050	0.6 max	U ～ X	-	BisA
1006FS	900 ～ 1,100	0.6 max	U ～ X	112	BisA
1007FS	1,200 ～ 1,400	0.6 max	X ～ Z1	124	BisA
1009F	1,750 ～ 2,250	1 max	Z3 ～ Z5	144	BisA
4005P	950 ～ 1,200	1 max	O ～ U	87	Bisphenol F (BisF)
4007P	2,000 ～ 2,500	1 max	X ～ Z2	108	BisF
4010P	3,800 ～ 4,600	1 max	Z4 ～ Z6-	135	BisF

(1) 40% butyl carbitol solution
(2) Ring-and-Ball Method

General (Multi functional type)

Grade	Sales specification			Typical value	Remarks
	WPE (g/eq)	Color / Gardner (-)	Viscosity / Capillary viscometer	Softening Point /(1) (℃)	
152	172 ～ 178	1 max	14 ～ 18 P (2)	–	Phenol Novolac
154	176 ～ 180	1 max	350 ～ 650 P (2)	–	Phenol Novolac
157S70	200 ～ 220	5 max (3)	65 ～ 85 cSt (3)	70	Bisphenol A novolac, Solid
1031S	180 ～ 220	–	B ～ F (4)	90	Tetrakis(hydroxyphenyl) ethane type, Solid
1032H60	163 ～ 175	10 max (5)	34 ～ 40 cSt (3)	62	Tris(hydroxyphenyl)methane type, Solid
604	110 ～ 130	15 max	50 ～ 100 P (6)	–	Diaminodiphenylmethane type, Semi-solid
630	90 ～ 106	5 max	5 ～ 10 P (7)	–	p-Aminophenol type

(1) Ring-and-Ball Method
(2) Brookfield viscometer, at 52℃
(3) 50% 1,4-dioxane solution, at 25℃
(4) 40% butyl carbitol solution, Gardner-Holdt, at 25℃
(5) 40% MEK solution
(6) At 50℃
(7) At 25℃

Contacts

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