



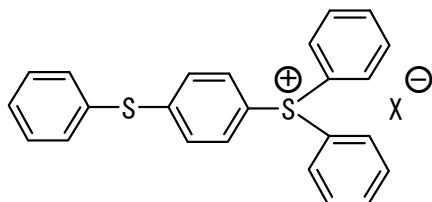
Jun.2, 2010

CPI-100P & CPI-101A

—Cationic Photo-Initiators—

CPI-100P and CPI-101A are newly developed cationic photo-initiators of triarylsulfonium salt-type with PF_6 and SbF_6 as anions, respectively (see the chemical structure below). In contrast to the conventional photo-initiators of this type, which are mixtures of mono- and bis-sulfonium salts, these new products comprise mainly mono-sulfonium salts with minimum amount of bis-sulfonium salts.

Bis-sulfonium salts in general are less soluble in organic matter than mono-sulfonium salts and adversely affect the storage stability of cationically photo-curable formulations. New photo-initiators resolve these drawbacks of the conventional products and are suited for photocuring either clear or pigmented formulations containing cycloaliphatic epoxies and other cationically polymerizable materials.



CPI-100P
X= PF_6

CPI-101A
X= SbF_6

Major Properties

Product	CPI-100P	CPI-101A
Appearance	Slightly yellow to yellow liquid	
Solid Content (%)	ca. 50 (w/w)	
Solvent	Propylene carbonate	

Features

1. CPI-100P and 101A contain mostly mono-sulfonium salts with minimum amount of bis-sulfonium salts.
2. Solubility of both products in monomers and solvents are the same as or better than the conventional triarylsulfonium salts.
3. Formulations comprising CPI-100P and 101A are thermally more stable than those containing the conventional photo-initiators.
4. According to our test, photocuring speed of a cationically polymerizable formulation comprising CPI-100P is slightly inferior to that containing the conventional product. But all customers who tested the new product say that its performance is not worse than the preceding product. Performance of CPI-101A is the same as the conventional product.

Performance

1. Solubility

Solubility of CPI-100P and 101A in cationically polymerizable monomers or organic solvents is equal to or better than the conventional triarylsulfonium salts.

Table 1. Solubility in Cationically Polymerizable Monomers

Initiator \ Monomer	Vinyl Ethers			Epoxy Resins	
	CHVE	TEGDVE	DVE	UVR-6110	Epikote 828
CPI-100P	×	○	×	○	○
Comparison-1	×	○	×	○	○
CPI-101A	×	○	×	○	○
Comparison-2	×	○	×	○	○

Note) Comparison-1: Conventional triarylsulfonium PF₆ in propylene carbonate (50% solution)

Comparison-2: Conventional triarylsulfonium SbF₆ in propylene carbonate (50% solution)

The structures of vinyl ethers and epoxies are listed at the bottom of this page.

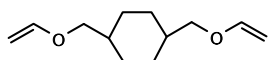
Table 2. Solubility in Organic Solvents

Initiator \ Solvent	Toluene	EtOAc	MeOH	i-PrOH	CHCl ₃	CH ₂ Cl ₂	THF	Acetone	MEK	MIBK
	CPI-100P	×	○	○	×	○	○	○	○	○
Comparison-1	×	×	×	×	△	○	○	○	○	×
CPI-101A	×	○	○	×	○	○	○	○	○	○
Comparison-1	×	○	○	×	○	○	○	○	○	○

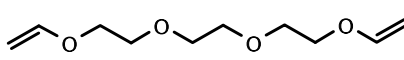
[Test Method]

To 100 parts of monomers or organic solvents, 20 parts of 50% propylene carbonate solutions of photo-initiators were added at room temperature and the solubility was judged from the appearance of the mixtures.

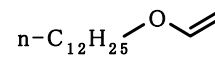
○: Clear (soluble) △: Slightly turbid ×: Turbid or separation of initiator



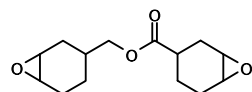
CHVE



TEGDVE



DVE



UVR-6110 : (Dow Chemical Co., Ltd)

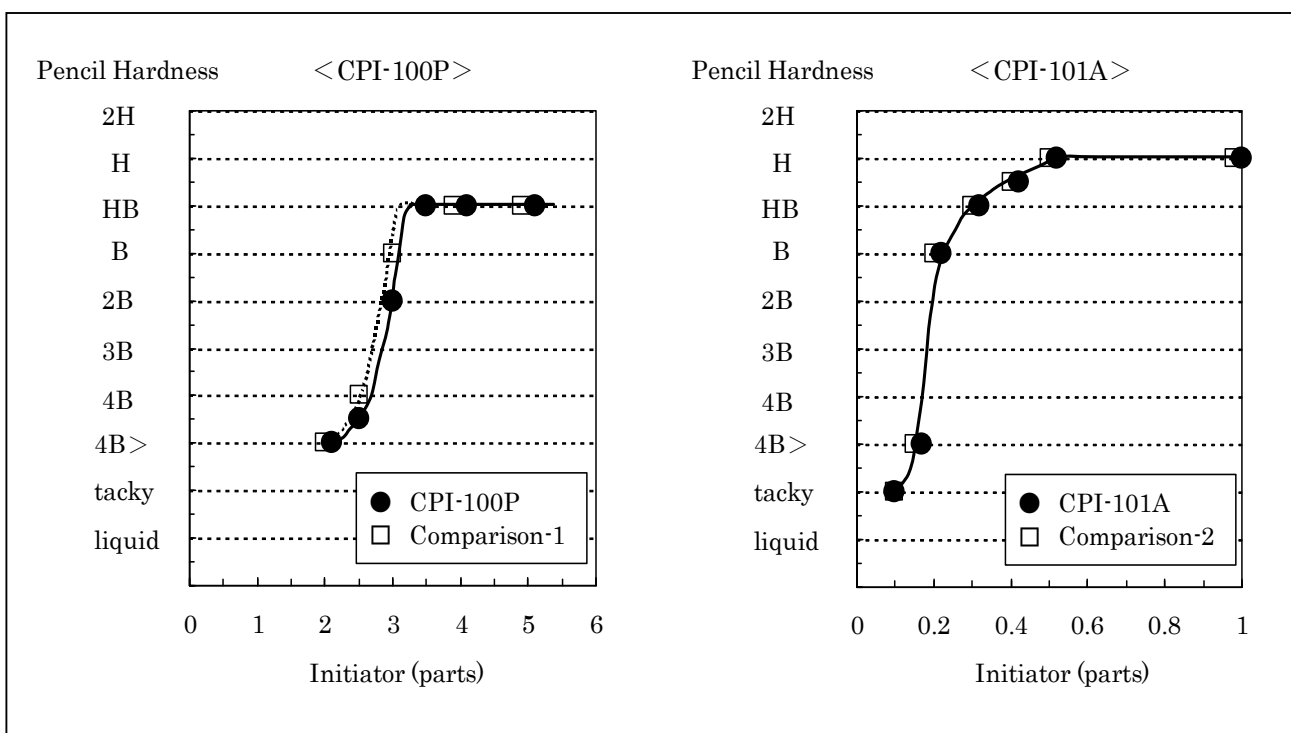
Epikote 828 : Bisphenol A-type epoxy resin
(Japan Epoxy Resins Co., Ltd)

2. Photocuring Ability

(1) Clear Composition

Photocuring abilities of CPI-100P and 101A were compared with commercially available triarylsulfonium salts. While CPI-100P seems to be slightly inferior to Comparison-1, performance of CPI-101A is the same as Comparison-2.

Figure 1. Amount of Initiator and Pencil Hardness of UV-cured Film.



[Test Method]:

To 100 parts of UVR-6110, cycloaliphatic epoxy resin supplied by DOW Chemical Co., a specified amount of the initiator solution was added. The mixture was UV-cured by the following condition. The pencil hardness of the cured film was measured 20 minutes after UV irradiation.

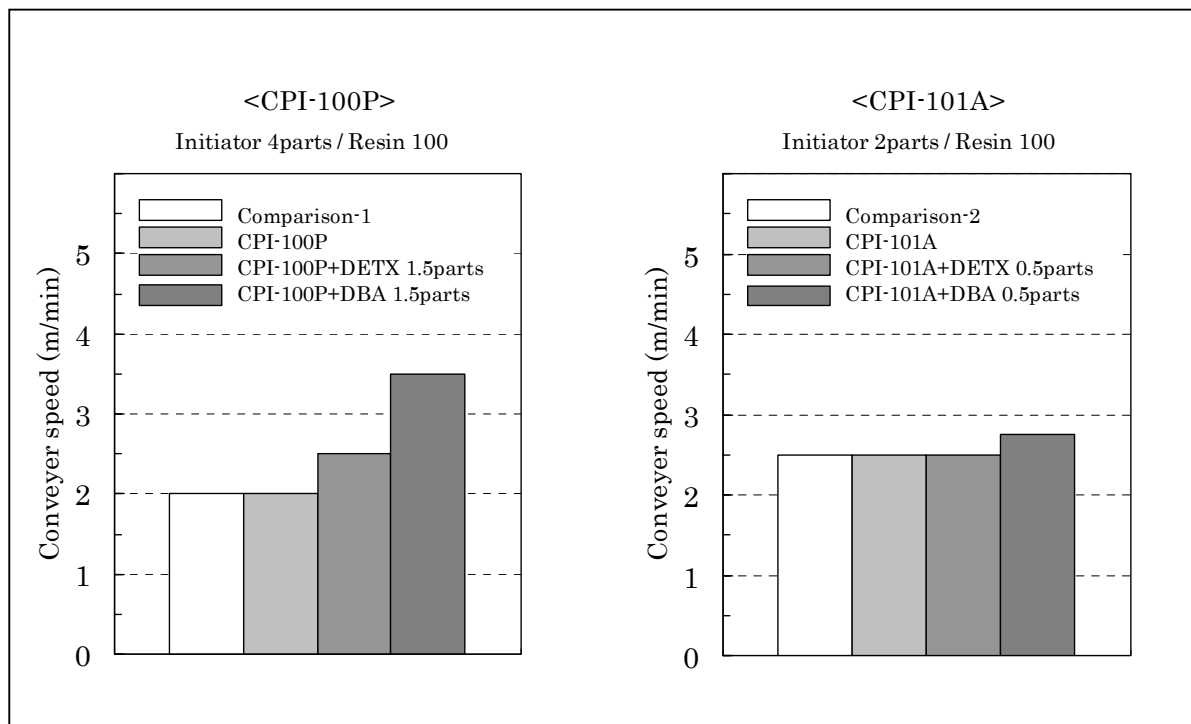
Condition of UV-Curing :

Apparatus: belt conveyer-type UV Irradiation Apparatus (Eye Graphics Co.,Ltd)
UV Lamp: metal-halide (120W/cm) . Irradiation distance: 18cm
Conveyer speed: 4m/min. × 1pass
Coating thickness: ca.40 μ m on PET film of 80 μ m thickness

(2) Pigmented Composition

Photocuring activities of CPI-100P and 101A of pigmented formulations (TiO₂) were the same as the commercially available triarylsulfonium salts, Comparison-1 and -2. Addition of the photo-sensitizer, especially anthracene-derivatives, showed some effect on the curing speed.

Figure 2. Conveyer Speed to Make the Pigmented Formulations Tack-free



[Test Method]

Maximum conveyer speeds to make the following formulations tack-free were determined.

Formulation

UVR-6110 : 100parts

TiO₂ : 100 parts

Initiators : Specified amount

Photo-sensitizer(*) : Specified amount

* DETX (2,4-diethyl-9H-thioxanthen-9-one) or DBA (9,10-dibutoxyanthracene)

Condition of UV-Curing:

Apparatus: belt conveyer-type UV Irradiation Apparatus (Eye Graphics Co., Ltd)

UV Lamp: metal-halide (120W/cm) . Irradiation distance: 18cm

Number of irradiation pass: 1

Coating thickness: ca. 6 μ m on PET film of 80 μ m thickness

3.Storage Stability

Epoxy resins containing CPI-100P and 101A are more storage-stable than these containing conventional photo-initiators.

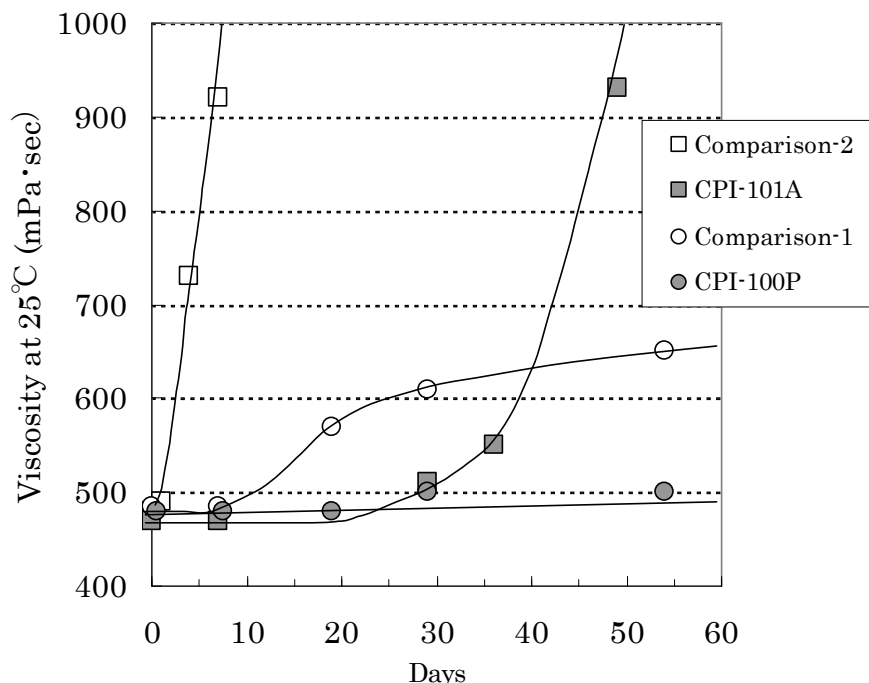


Fig.3 Viscosity Change of Epoxy Resin Containing Sulfonium Salts at 80°C.

[Test Method]

The following formulations were kept at 80°C and viscosities of the solutions were measured periodically at 25°C.

Formulation

UVR-6110 : 100 parts

Initiators : 5 parts of CPI-100P or Comparison-1

3 parts of CPI-101A or Comparison-2

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