

Poly carbonate resin for optical disc

Hisayoshi Shimizu
Plastic Market Development Department
Teijin Chemicals Ltd.

ABSTRACT

Polycarbonate resin(PC) is known as an Engineering Plastic in the world. One of the most efficient application is the optical disc substrate material. PC Optical grade is used for all types of optical disc substrate from CD(Compact Disc) to BD(Blu ray Disc). Teijin Chemicals Ltd. developed PC optical grade which is suitable injection molding process for CD substrate in 1981. After that PC optical grade is used not only optical disc substrate but also Laser pick up, aspherical lenses and other optical devices.

Teijin Chemicals Ltd. developed several type of PC optical grades. For example, very low birefringence, higher Tg compare to conventional PC optical grade, more stable dimensional stability under higher rotation speed, higher refractive index.etc..These new PC grades are used for high quality CD(Blu Spec CD*1), Magneto-optical disc, Hologram disc, high resolution optical lenses for CCD camera. PC has big potential to modify of it's properties to meet next generation optical recording system for professional use.

*1 ; Blu-spec CD is produced by SONY Music Entertainment.

PC OPTICAL GRADE

PC optical grade AD-5503 was developed by Teijin Chemicals Ltd. in 1981 designed for Compact Disc(CD) substrate. AD-5503 is a Bis-phenol A type PC.

PC is a general term of carbonate bond included molecular structure. Generally, PC means Bis-phenol A type PC.

AD-5503 has high heat stability during injection molding process, very low contamination level and lot by lot stability. Especially, DVD and Blu-ray disc production process required high injection temperature. So that it is necessary PC resin's heat stability. Fig. 2 shows DVD substrate heat stability test result.

AD-5503 has 380°CX15min. heating stability.

AD-5503 is suitable for injection stamp molding process which is main process of optical disc substrate, optical grid and optical lens production.

PC OPTICAL FILM

Teijin Chemicals Ltd. provides PC optical film for Blu-ray disc recordable cover film and LCD TV display phase control film application.

There are 2 types of PC optical film. One is high molecular weight PC casted film (Pure Ace™ ; C-110 series) and another is AD-5503 extruded film (Panlite film™ ; D-series)

Casted PC optical film has higher Tg(160°C) and toughness. Extruded PC optical film has 145°C of Tg. Both PC optical film has almost same optical and dimensional properties.

Fig. 3 shows PC optical films.

Extruded PC Panlite™ film is used for 3D optical eyeglass and Blu-ray disc recordable cover film.

Casted PC Pure Ace™ film is useful for ITO touch panel base film and high speed rotation thin film type optical disc base.

NEW PC OPTICAL GRADE

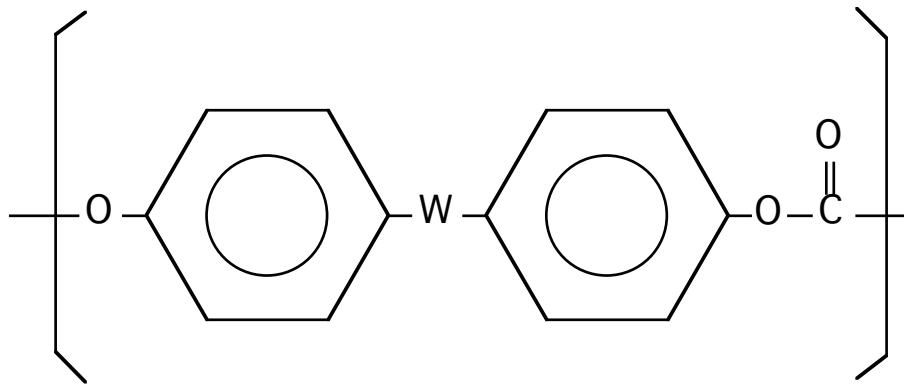
Bis-phenol A type PC has a room to improve properties. In case of high quality optical disc substrate production, AD-5503 has some possibility to make brittle and tilted substrate depending on production condition. To avoid this kind of phenomenon, new PC optical grade Z-1117R was developed. This grade has higher molecular weight compare to AD-5503. It has also better mold releasability. So that it makes better pit and groove shape during injection molding process. It is suitable to make high quality CD and Archive ROM disc instead of HDD ,SSD or tape media.

Another molecular structure PC is also available. Teijin Chemicals Ltd. proposed new molecular structure PC (SP series). These PC has non Bis-phenol A structure. Main difference properties compare to Bis-phenol A type PC are low photo-elasticity coefficient, higher Tg, higher refractive index.

SP series are suitable for optical lenses and grids without optical distortion.

Fig. 4 shows under crossed nicols condition sample plates to see optical distortion. Each plate produced by injection molding process. Remaining stress makes optical distortion after molding. SP series has smaller optical distortion

Heat treatment is also available to reduce remaining stress and optical distortion.



Polycarbonate Molecular Structure
W part makes different character.

W Structure	PHOTO Elasticity	Tg	Moisture Absorption
$\begin{array}{c} \text{CH}_3 \\ \\ -\text{C}- \\ \\ \text{CH}_3 \end{array}$	$72 \times 10^{-13} \text{ cm}^2/\text{dyn}$	145°C	0.27%
	$68 \times 10^{-13} \text{ cm}^2/\text{dyn}$	170°C	0.28%
$\begin{array}{c} \text{CH}_3 \\ \\ -\text{C}- \\ \\ \text{C}_6\text{H}_5 \end{array}$	$55 \times 10^{-13} \text{ cm}^2/\text{dyn}$	180°C	0.43%
$\begin{array}{c} \text{C}_6\text{H}_5 \\ \\ -\text{C}- \\ \\ \text{C}_6\text{H}_5 \end{array}$	$16 \times 10^{-13} \text{ cm}^2/\text{dyn}$	198°C	-
	$32 \times 10^{-13} \text{ cm}^2/\text{dyn}$	234°C	-

Fig.1 PC molecular structure

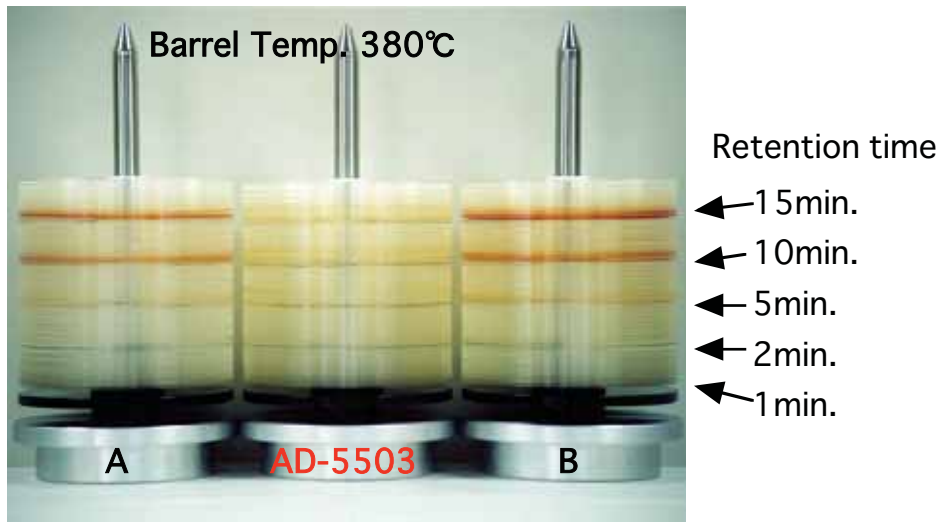


Fig.2 PC Heat stability test



PC Casted Optical film



PC Extruded film

Fig. 3 PC optical film

	SP- 1516	SP- 1715	SD- 1414
After heat treatment (Tg - 15°C)			
Original			

Fig. 4 SP series Retardation(Optical distortion)