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Low Coefficient of Linear Thermal Expansion Polyimide Film for Device Substrate.

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ABSTRACT:

In this study, we introduced the polyimide film "XENOMAX®" with the same coefficient of linear thermal expansion (CTE) as Si and LCD glass. It was indicated that this film is useful as a flexible substrate. In order to make a device on this film, we also developed an attachment technology to glass. This technology can use 400℃ process. By removing polyimide film from glass, making the device on the film becomes easier.

1. Background

It is worth noting that substrate's property affects the flexible device's performance. It is well known that CTE mismatch causes curving.[1] There are different kinds of substrate materials such as Steel Use Stainless (SUS), thin glass and polymer film. However, thin glass is excellent in terms of CTE. In many cases, low CTE and gas barrier property are required in order to use polymer film as a device substrate. The gas barrier property can respond by depositing barrier thin film. On the other hand, low CTE is the characteristic required for the film itself. In this report, we described the film of low CTE.[2), 3)]

2. Results and Discussion

As shown in Figure 1, CTE of this film (in-plane direction) shows 3 ppm/ ℃ equivalent to Si and glass in 450 ℃ from room temperature. These CTE was measured by Thermomechanical analyzer (TMA). For comparison, Si, LCD glass, Copper foil, and two kinds of conventional polyimide were measured. Two polyimide films are polyimide with PMDA-ODA and BPDA-PDA, respectively. CTE in this common polyimide is 15～20 ppm/℃ in the range of 200 ℃ from room temperature. The heat shrink of XENOMAX® in 400℃ is also small as 0.1% or less. (Table 1) XENOMAX® shows similar mechanical properties to those of Polyimide B, which indicates that XENOMAX® does not require special care for its handling in various film processes.

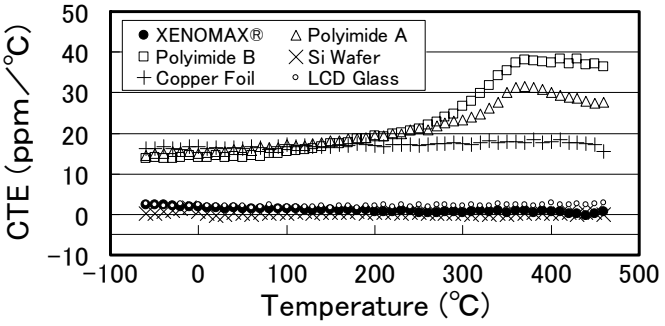

Fig. 1 Temperature dependence of CTE

Our result indicated that this film can bear 400℃ during a process for about 1 hour.

At the time of oral presentation, the attachment technology of a film will be described.

Table 1 Comparison between XENOMAX® film and other Polyimide Films

Characteristic item		Polyimide film			Remarks
		XENOMAX®	Polyimide A (PMDA/ODA)	Polyimide B (BPDA/PDA)	
Young's Modulus	GPa	8	5.2	8.9	
Tensile strength	MPa	440−530	360	540	
Elongation at break	%	30～45	60～70	50	
Tear strength	N/mm	2.4	3.4	2.7	
thermal shrinkage	%	0.01／0.01	0.01／−0.02	0.03／0.05	200℃、10min.
MD／TD	%	0.09／0.03	0.74／0.74	0.60／0.65	400℃、2Hr

1) S. Wagner, et. al., in *Flexible Flat Panel Displays*, ed. G.. P. Crawford (Wiley 2005) p263.
2) T.Okuyama, et. al., IDW'13 FLX4-1 p1542 (2013)
3) T.Okuyama, Denshizairyou **47**, No.1, p77 (2008) [in Japanese]