Plastic Substrate for Flexible TFT LCD

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Abstracts

Plastic substrate for flexible TFT LCD is developed. The gas barrier, optical properties and conductivity in the substrate is improved through depositing silicon oxide/nitride layer and ITO layer, coating polymer layer on plastic film by sputtering process and wet coating process. The whole production process of the plastic substrate is guaranteed the productivity by using roll to roll process..

Introduction

The researches and developments about plastic based flat panel display have been widely advanced[1,2]. The customer driven factors into the flexible display market include reduced weight, reduced thickness, good resistance to breakage, compatibility of roll to roll process, lower cost.

There are some serious issues in fabricating flat panel display using the plastic substrate. First, the mechanical stability of plastic substrate must be ensured in panel fabrication process. The problems of mechanical stability include heat resistance, dimensional stability in each process. Second, The performance of plastic display must be equivalent to that of conventional display. The birefringence, transmission, and gas barrier property of plastic substrate should satisfy requirements of substrate for flat panel display[3,4,5].

We focused gas barrier property, conductivity, optical transmittance and productivity of plastic substrate in this work. For gas barrier property, inorganic layer shows effective results. And ITO layer was deposited on polymer layer. We produce should select carefully ITO process condition and the kinds of polymer layer to satisfy high conductivity for TFT LCD.[6]

Results and Discussions

We produced the PES film having a superior resistance to heat and the excellent optical properties of PES film such as retardation, transmittance, haze, and yellow index. The transmittance was 88% at 550 nm, retardation below 8 nm, haze below 0.3 %, Yellow index below 2.5, and surface roughness below 5 nm of 200 um PES film.

The inorganic layer and polymer layer was coated for effective gas barrier layer. We used silicon oxide or silicon nitride material as gas barrier material. The common thickness is 15-20nm for silicon oxide and silicon nitride. The polymer coated plastic substrate shows excellent scratch resistance and solvent resistance.

And ITO layer was deposited on polymer layer by the sputtering process. The sputtering process was optimized for highly optical transmittance and conductivity. We improved interfacial bond strength between ITO layer and polymer layer for the stability of flexible substrate. Sheet resistance can be less than 50Ω/□, with a optical transmittance (@550nm) of ＞80%.

The gas barrier property of developed plastic substrate is about 0.01 g/m^2/day.

The ITO coated PES substrate shows increased optical

transmittance of barrier film.(Figure 1) The ITO coated plastic substrate shows excellent scratch resistance and solvent resistance. Table 1 shows the physical properties of the ITO coated PES substrate.

Conclusion

We use roll to roll process in whole production process-film extrusion, PVD process, wet coating process. Roll to roll process make it possible to produce lower cost plastic substrate. The mass-production of plastic substrate has allowed us to approach commercialization of flexible plastic display. We improved the performance of plastic substrate to satisfy the requirements of plastic substrate for TFT-LCD in many sides.

New plastic substrate we developed shows strong possibility to commercialize various flexible display such as electronic paper, plastic LCD, flexible organic light emitting display.

References

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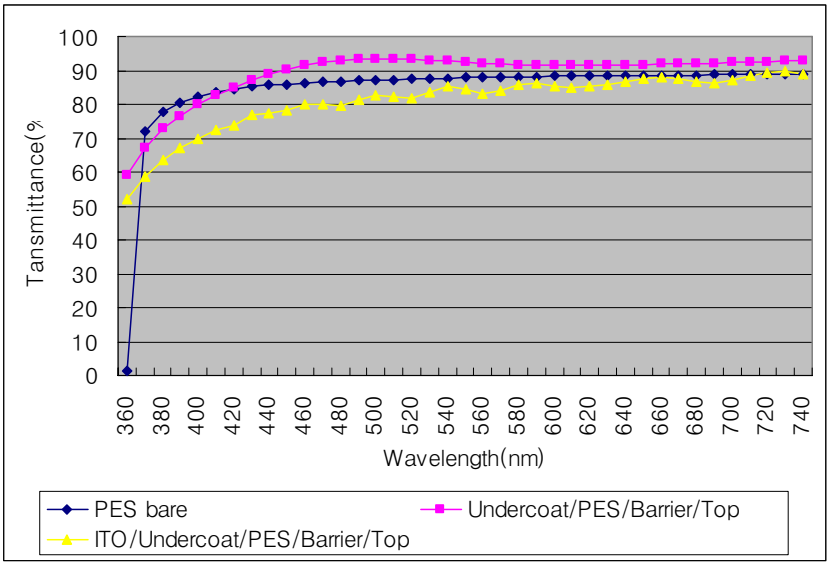

Figure 1. Optical transmittance data of top coated barrier film

Items	Unit	Conditions	ITO/undercoat/PES/Si_3N_4/topcoat
Light Transmittance	%	@550 nm	84.62
YI			7.34
Haze	%		0.2
Film retardation	nm		3.5
Scratch resistance			good
Water Vapor Transmission Rate	g/(m^2day)	Temp 37.8℃, RH 100%, 24h	0.001
Oxygen Transmission Rate	cc/(m^2 day)	Temp 35℃, O_2 100%, 24h	0.001
Thermal stability	R1/R0	180℃, 30min	0.80
Chemical resistance	R1/R0	Soaking 10min NMP solvent	1.20

Table 1. Physical properties of ITO coated PES substrate(R1: WVTR of treated sample, R0: WVTR of non-treated sample)