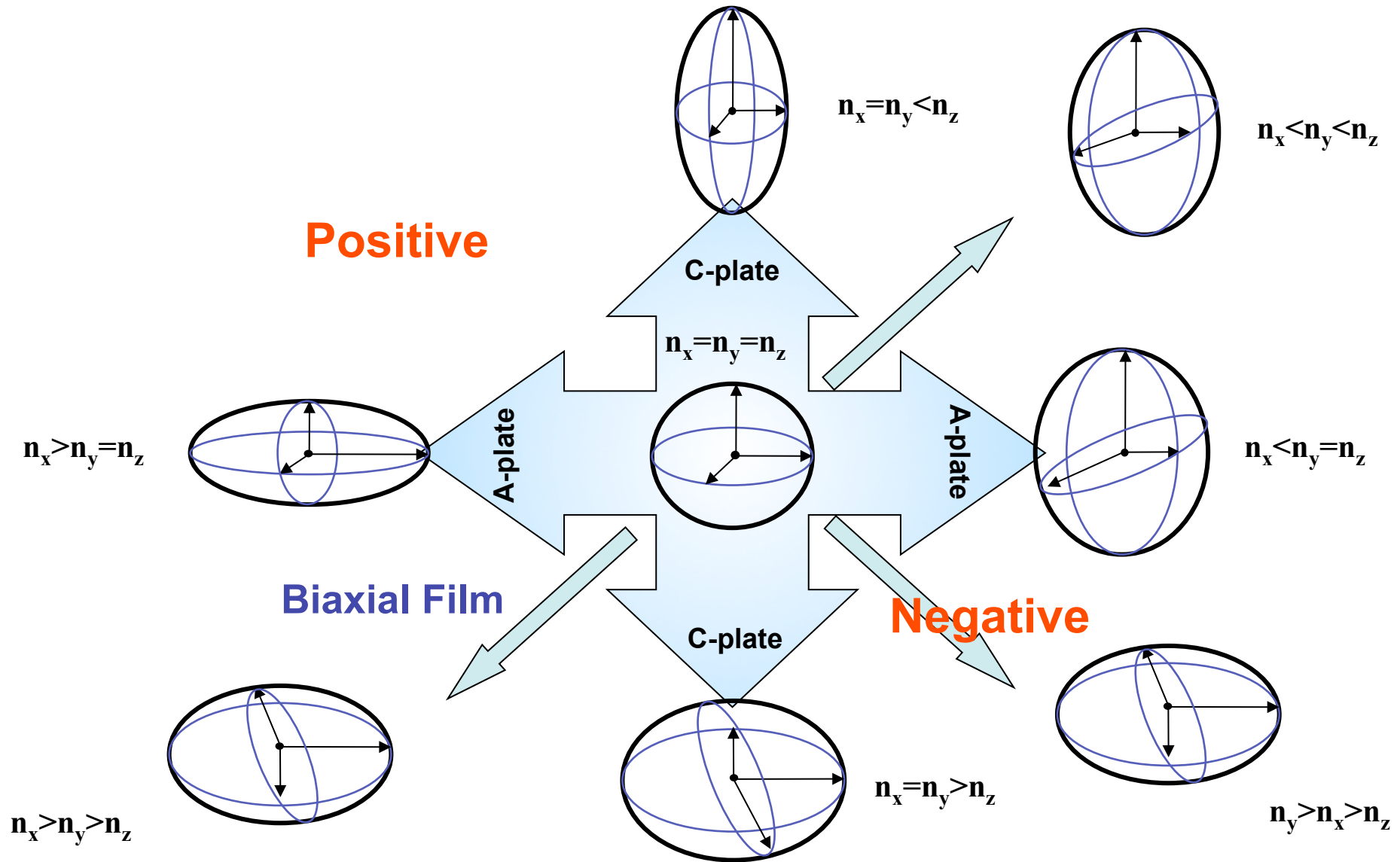
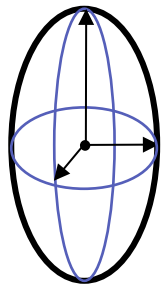


광시야각 보상 필름의 종류

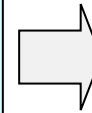
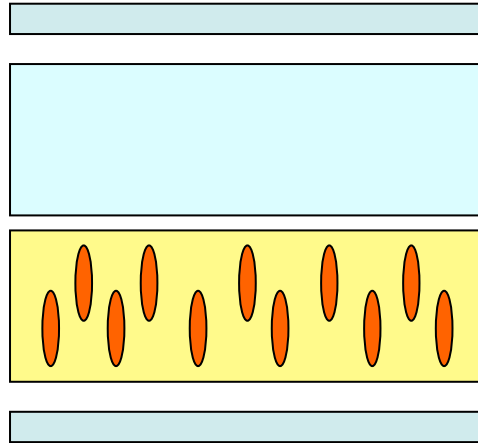


TN 모드에서의 광보상 Film 적용

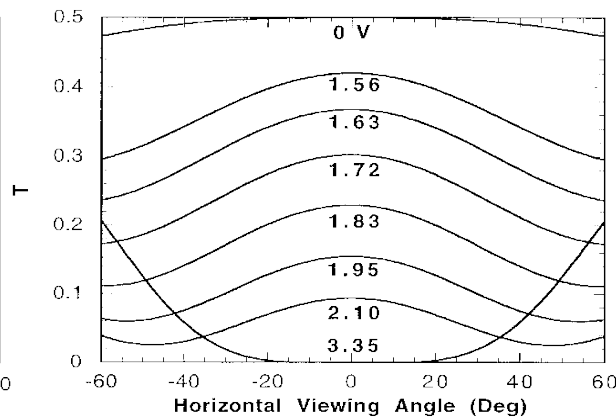
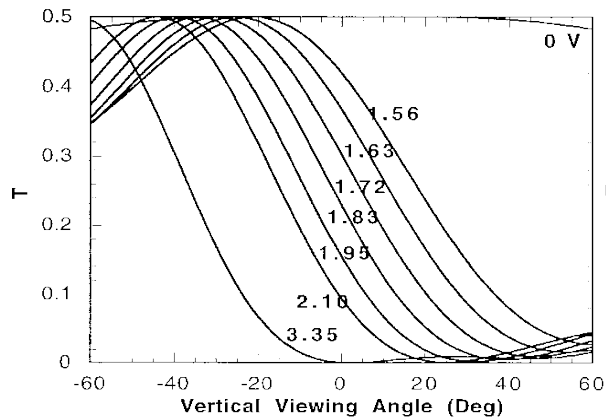
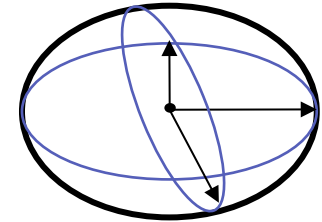
- Black 상태의 보상



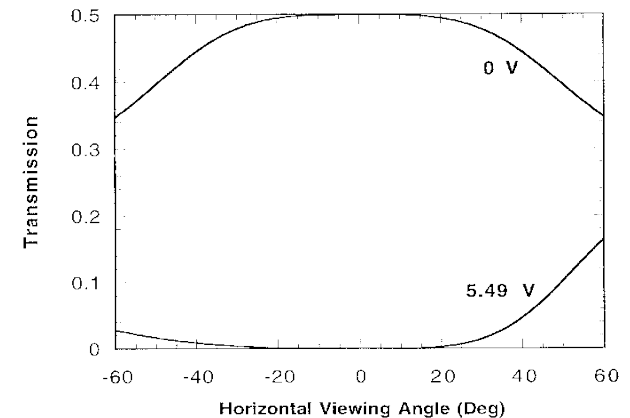
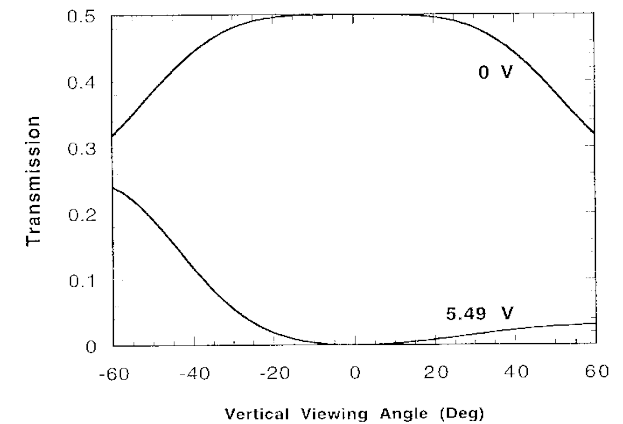
Positive c-plate



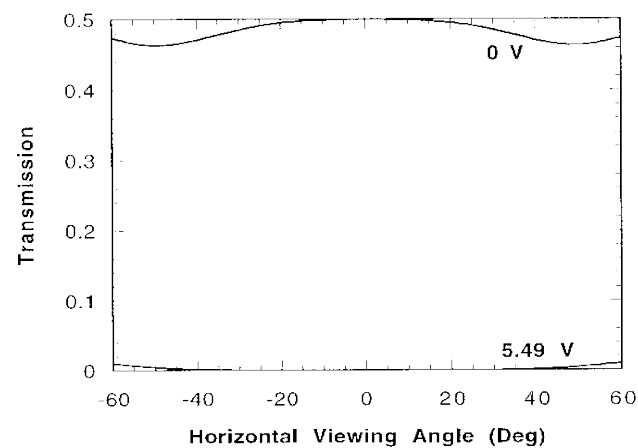
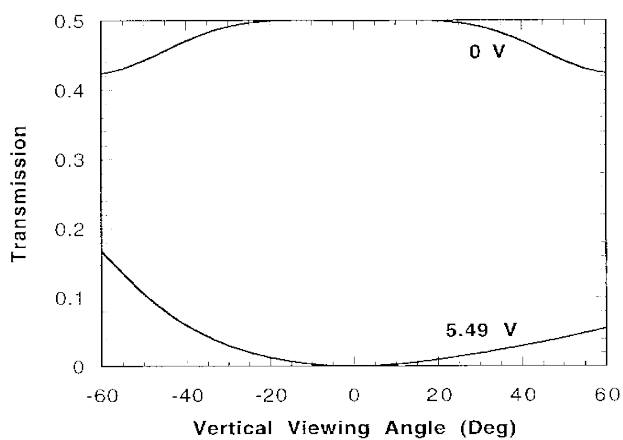
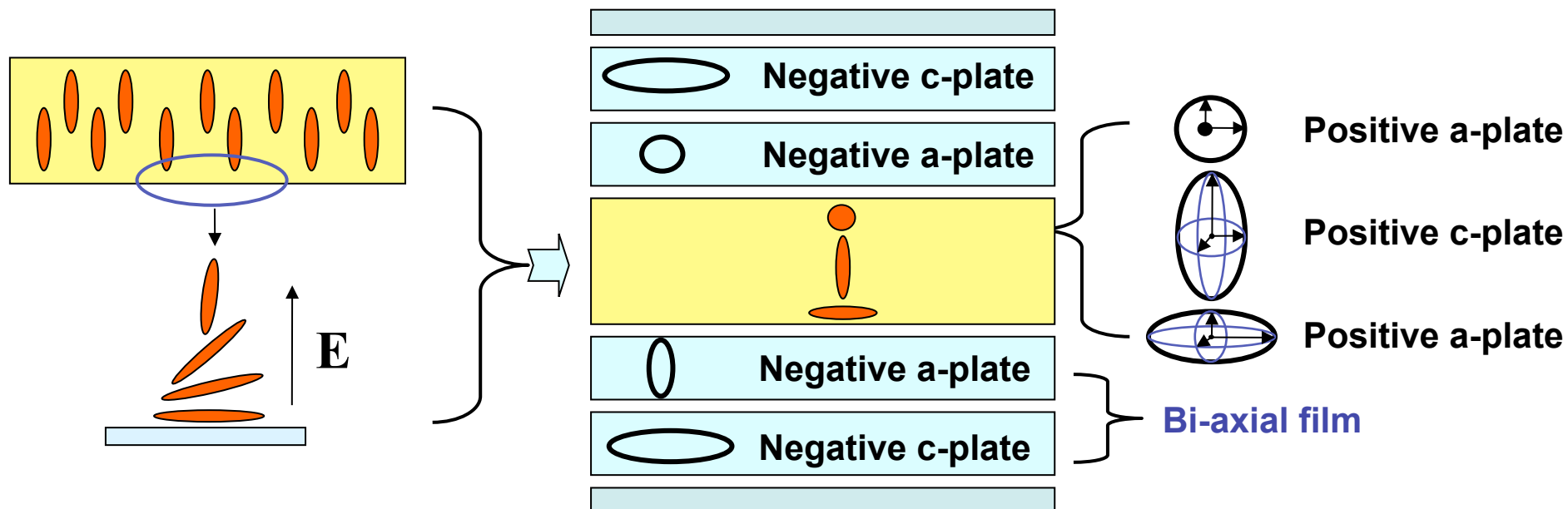
Negative c-plate



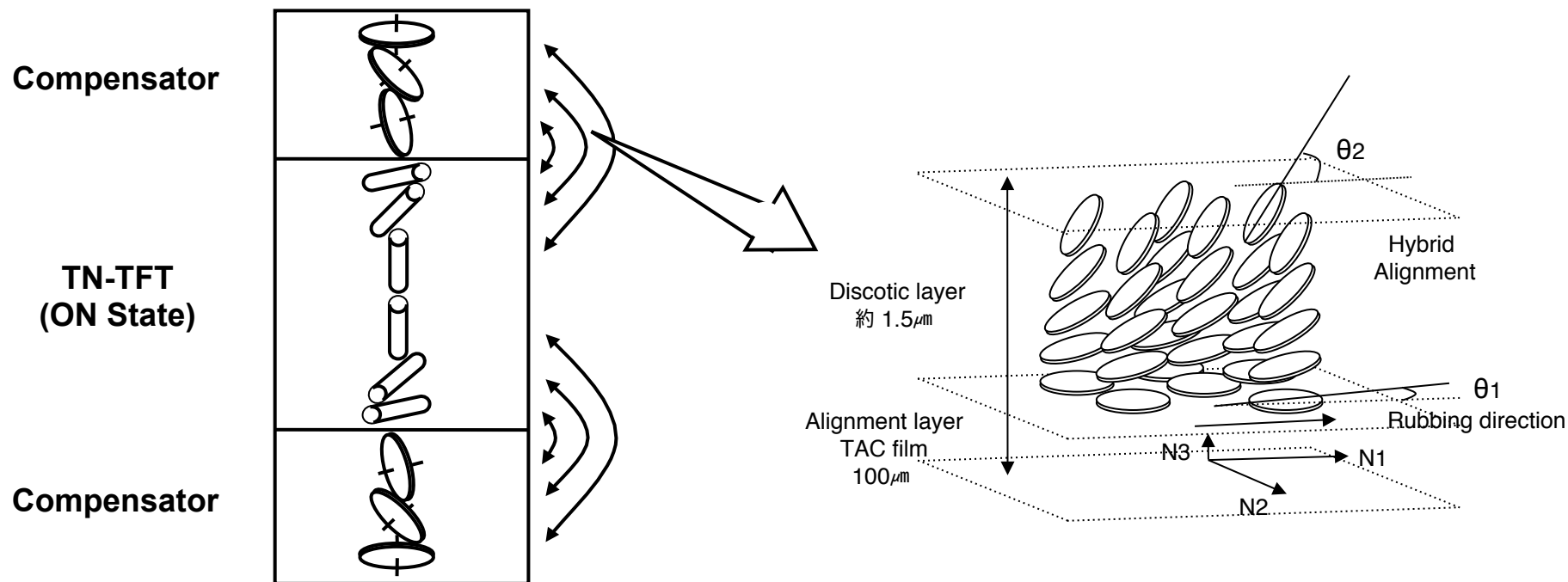
Without c-plate



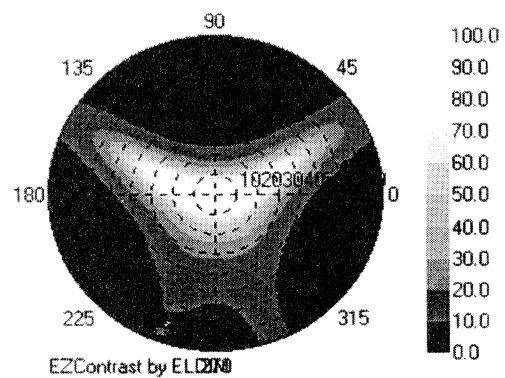
TN 모드에서의 광보상 Film 적용



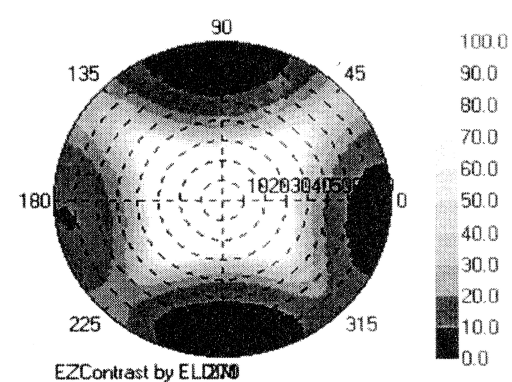
TN 모드에서의 광시야각 Film 적용



Contrast



Without compensator



With compensator

Image Quality Comparison between TN and WVTN

upper 15deg.
left 70deg



upper 15
right 70



upper 30deg.



left 60deg.

front view

right 60deg.



lower 45deg.



lower 60deg.

TFT-LCD
with the film

conventional
TFT-LCD

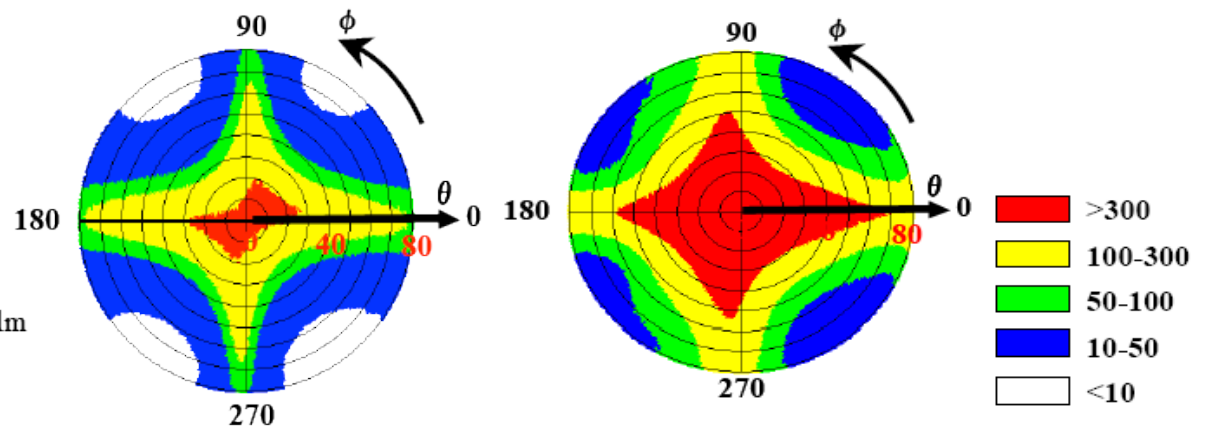
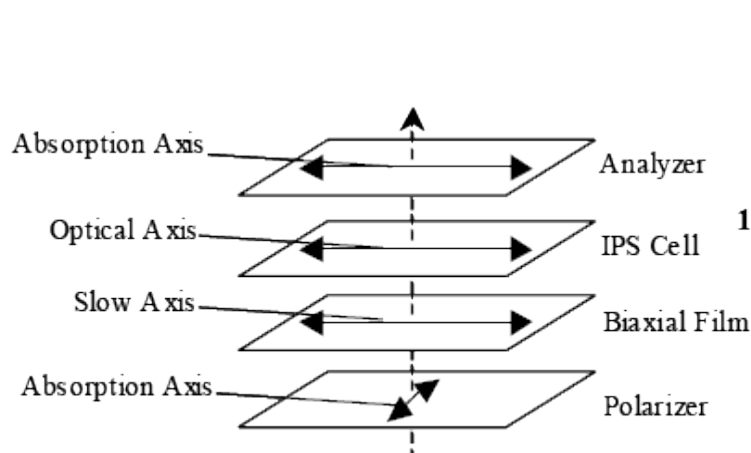
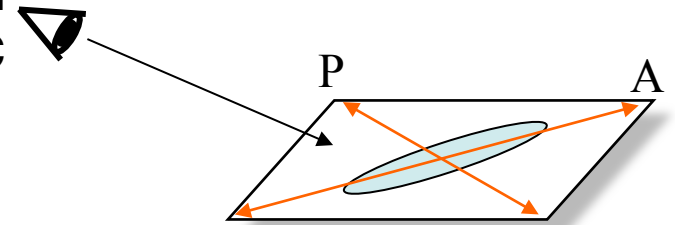
Optical Compensation in Dark State

Q : Need a compensation film for IPS?

[?] Uncompensated IPS and FFS cell

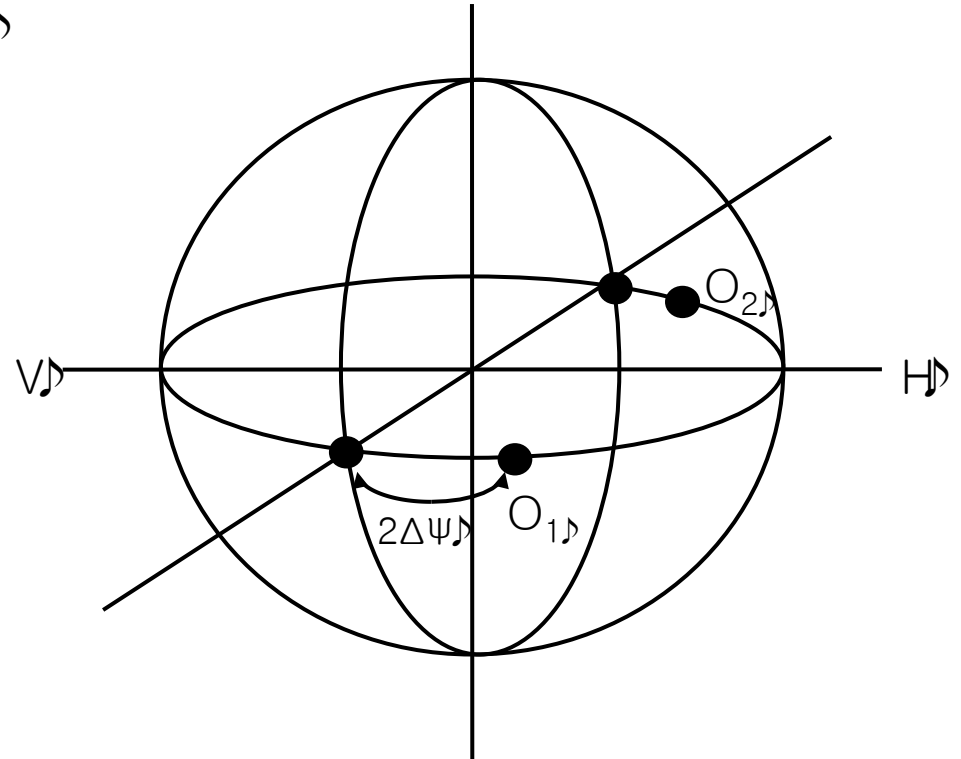
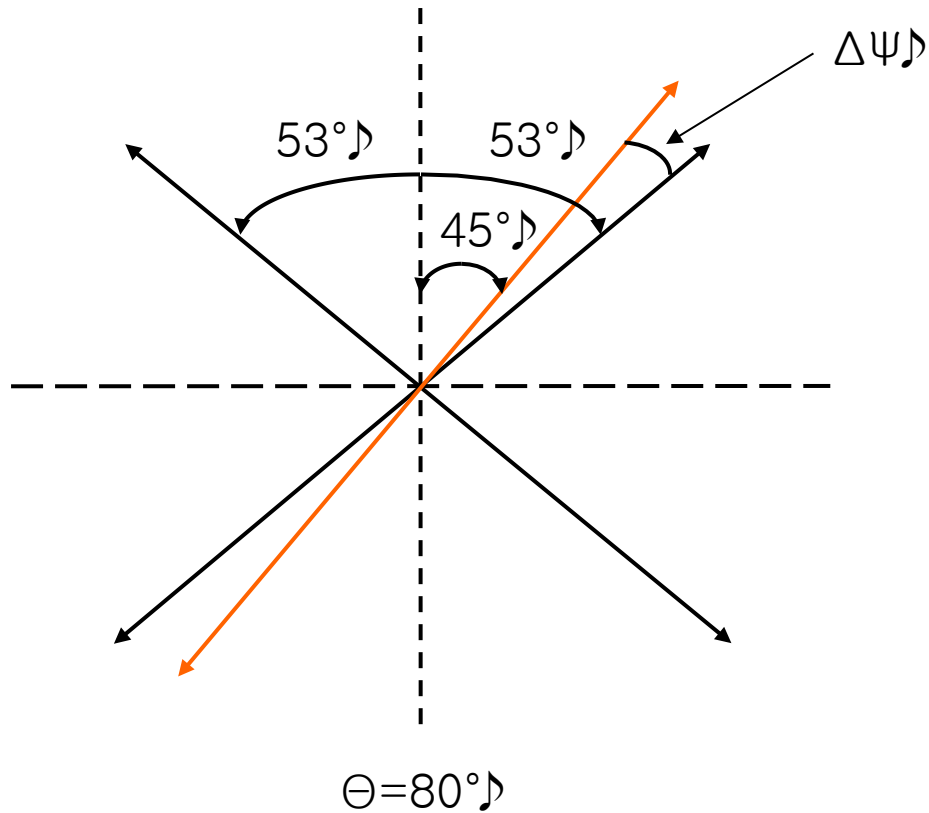
IPS has better viewing angle characteristics than other modes owing to the in-plane rotation of the LC director

[?] However, to accomplish a perfect dark state comparable to the CRT, they must be compensated by one or more films in the dark state.



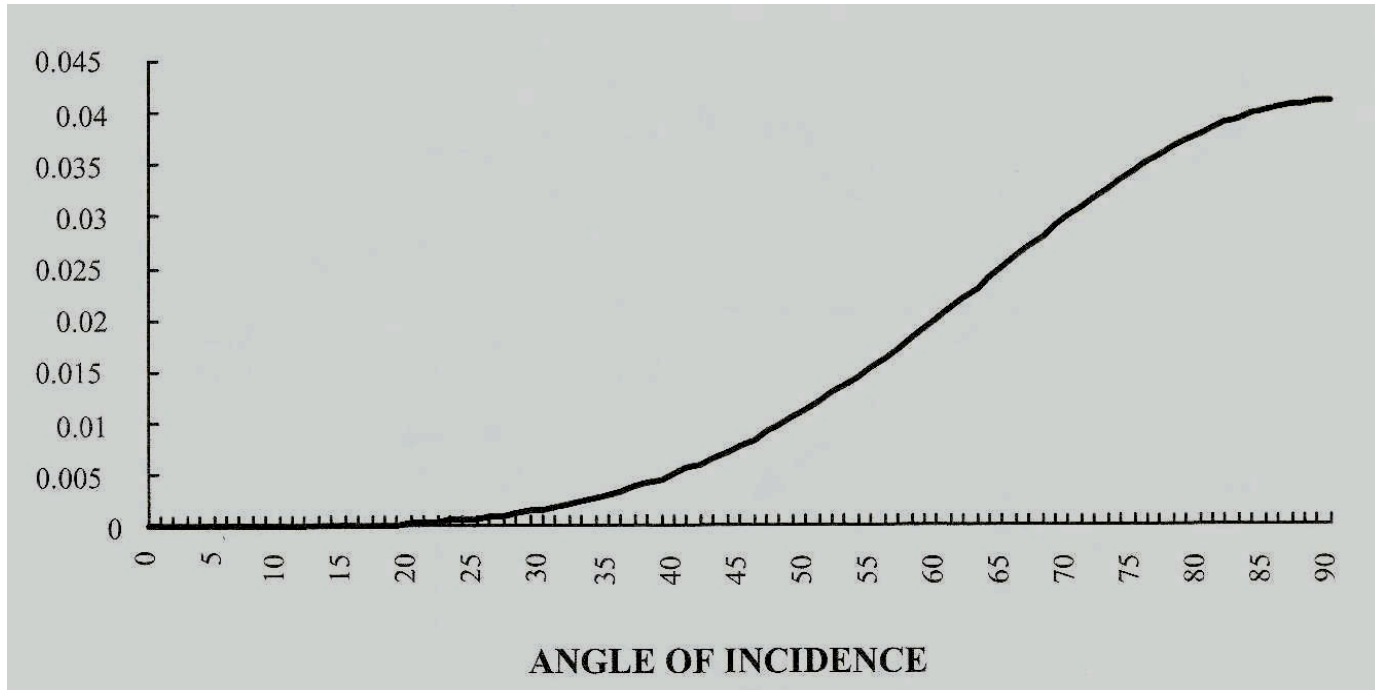
(a) conventional IPS-LCD (b) IPS-LCD (IPS-Pro) with a biaxial film.

❓ Transmission through Crossed Polarizers



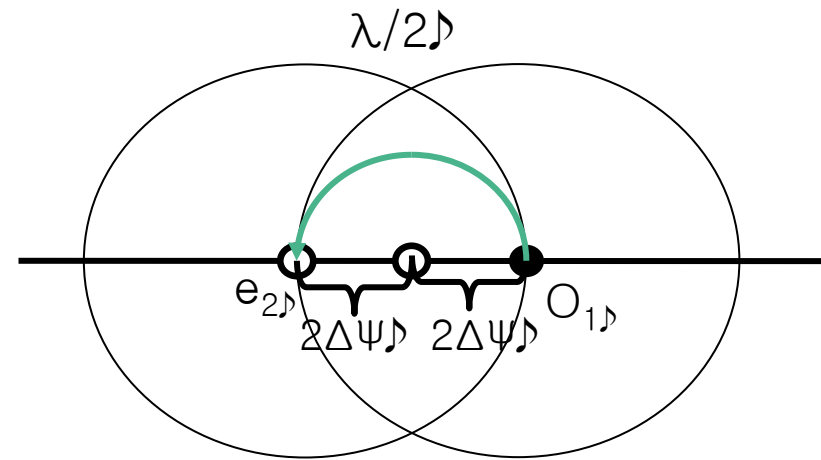
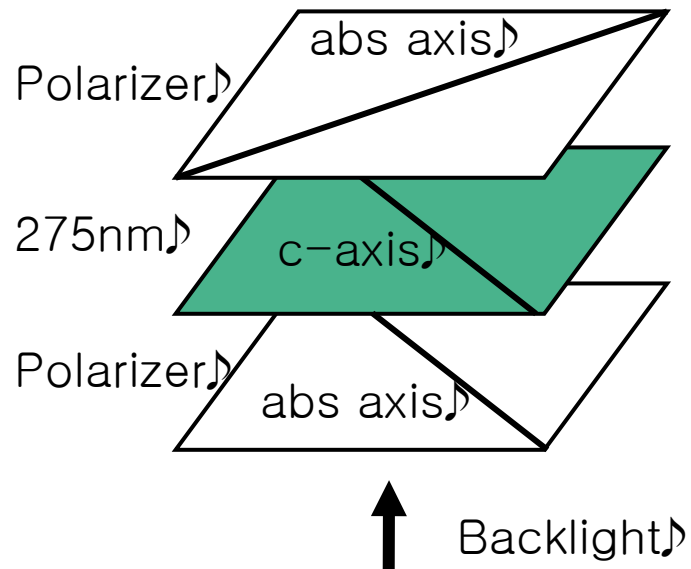
- Most sheet polarizers in LCDs are made of uniaxial materials.
- The deviation from 45° ($\Delta\Psi$) can be as big as 8° at $\Theta = 80^\circ$.

❓ Leakage of Light through Crossed Polarizers



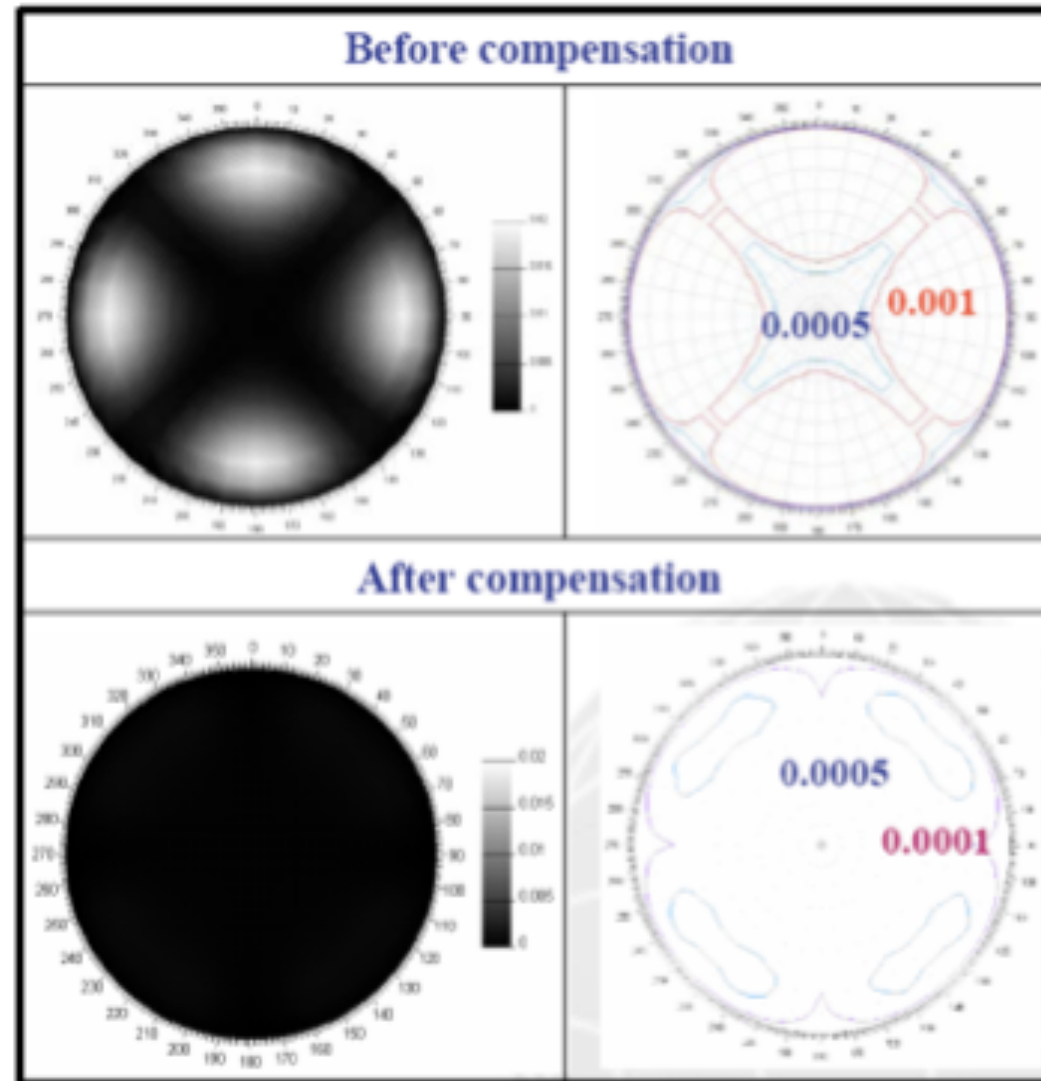
Angle of Incidence	0°	20°	40°	60°	80°
Leakage of Light	0	0.04%	0.5%	2%	4%

[?] Biaxial Compensators for Polarizers



- A single biaxial plate with its principal axis of the largest index aligned parallel to the absorption axis of the first polarizer. Furthermore, the plate surface is parallel to the OAP.

Iso-luminance contour (crossed polarizers)



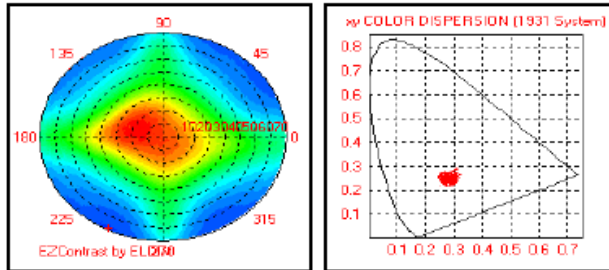
* Tatsuo Uchida et al, EURODISPLAY 2002, p. 173 (2002)

IPS 특징 정리

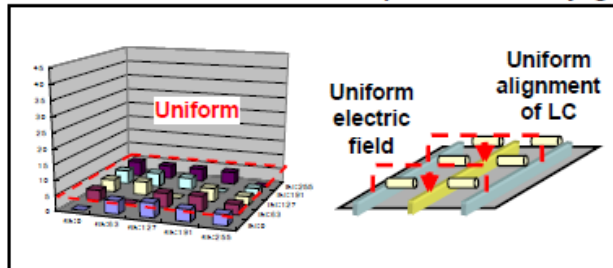
• IPS mode 특성 정리

장점

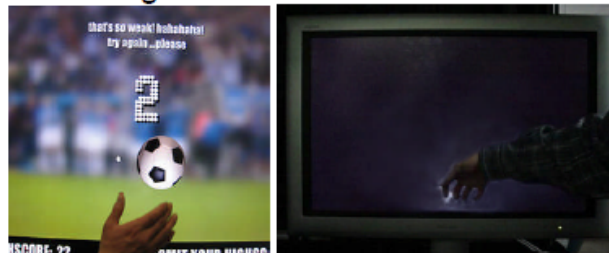
- ✓ Wide Viewing angle in any color & gray



- ✓ Fast & Uniform LC response for any gray



- ✓ Strong Touch characteristics



단점

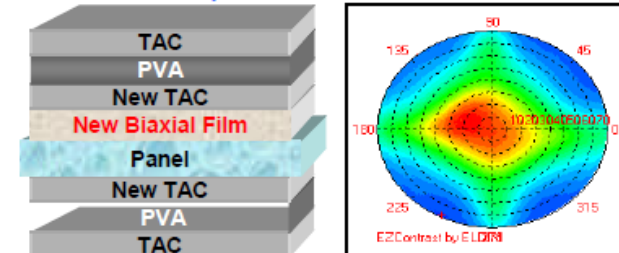
- ✓ Contrast Ratio (CR ~ 2000:1)

→ Local Dimming BLU

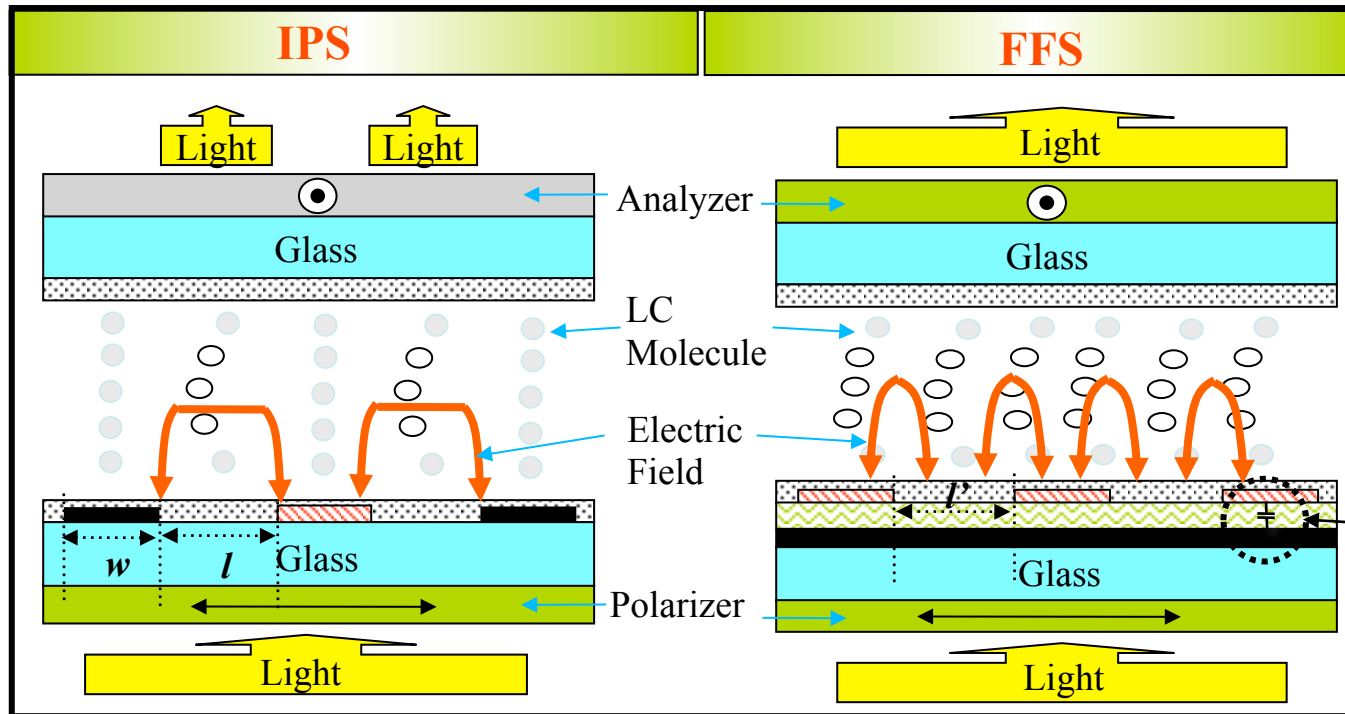


- ✓ High Black Luminance at diagonal direction

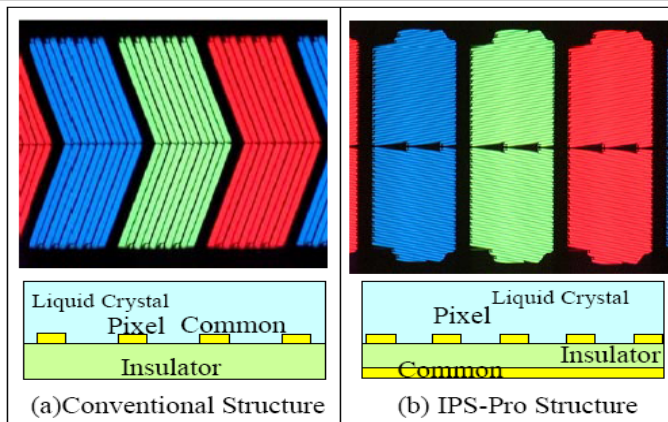
→ A-TW Compensation Film



Fringe-Field Switching (FFS)

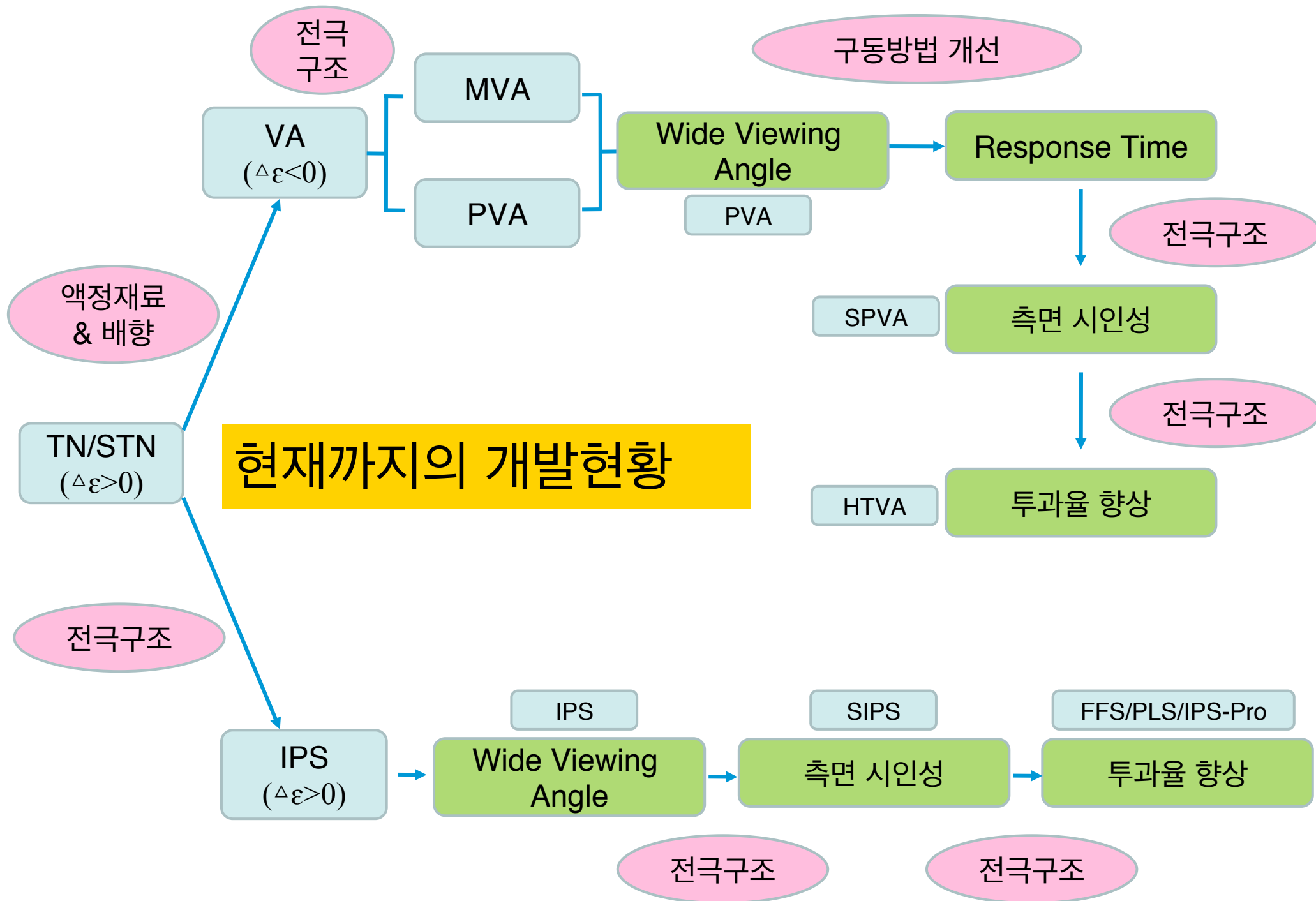


S.H. Lee et al,
Asia Display '98
Appl. Phys. Lett. '98



FFS:
Wide Viewing Angle/
High Transmittance





Summary

Name	Cell structure	제품군	특징	장점	단점	기타
TN mode (Twist Nematic)		• OA 제품 • Lap-top • Monitor	• Normally white • Δn_d : 400~420 • pretilt: $\sim 5^\circ$ • LC : positive LC	• 고휘도 • 고속응답 • 저소비전력 • 고생산성	• 협시야각 : 상하방향 시야각 비대칭 • 고가 보상필름 (WV film)	• All LCD manufacturers
VA mode (Vertical Alignment)		• TV	• Normally black • Δn_d : 290~310 • pretilt: 90° • LC : negative LC	• 고 CR • 광 시야각 • 고속응답 • 저렴한 보상필름	• 측면 시인성 미흡 • Bruising (멍자국)	• shutter-glass 3D • Samsung, Taiwan companies
IPS mode (In-Plane Switching)		• TV	• Normally black • Δn_d : 300~320 • pretilt: $1\sim 2^\circ$ • LC : positive LC	• 광시야각 • 우수한 측면 시인성 • 고속응답	• 정면 CR VA대비 낮음 • 보상필름 고가	• FPR 3D • LGD, JDI, BOE
FFS mode (Fringe field switching mode)		• Mobile	• Normally black • Δn_d : 320~340 • pretilt: $1\sim 2^\circ$ • LC : positive LC	• 광시야각 • 고투과율 (특히 고해상도에 서) • 측면시인성 우수	• 낮은 생산성 (비용) • 낮은 CR	• LGD, Samsung, JDI, AUO, BOE