



National Taiwan University

低電壓高對比之超分子液晶顯示技術

Low Driving Voltage and High Contrast Ratio
Supramolecular Liquid-Crystal Gels Formed by
Anisotropic Self-Assembly of π -Conjugated Polymers

Laboratory of Liquid Crystal Display

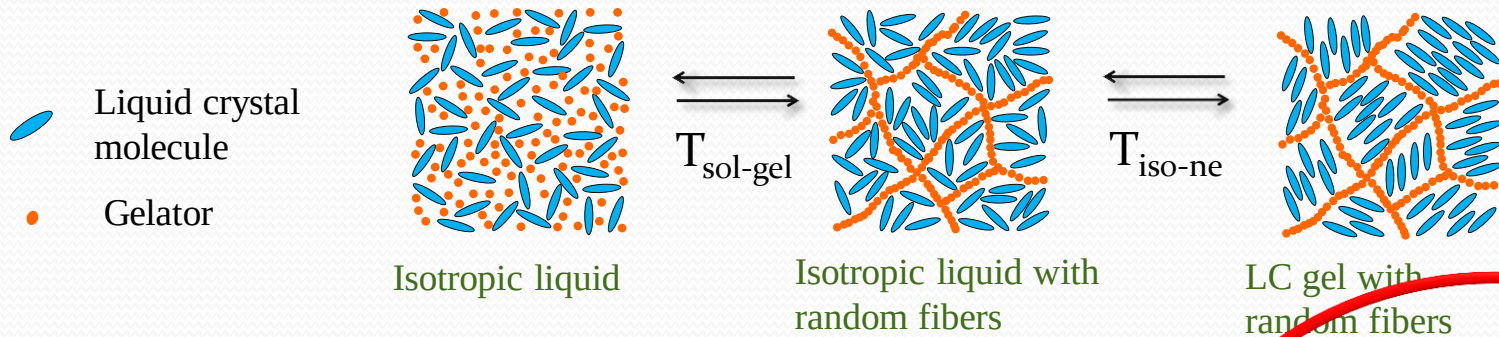
Department of Physics, National Taiwan University



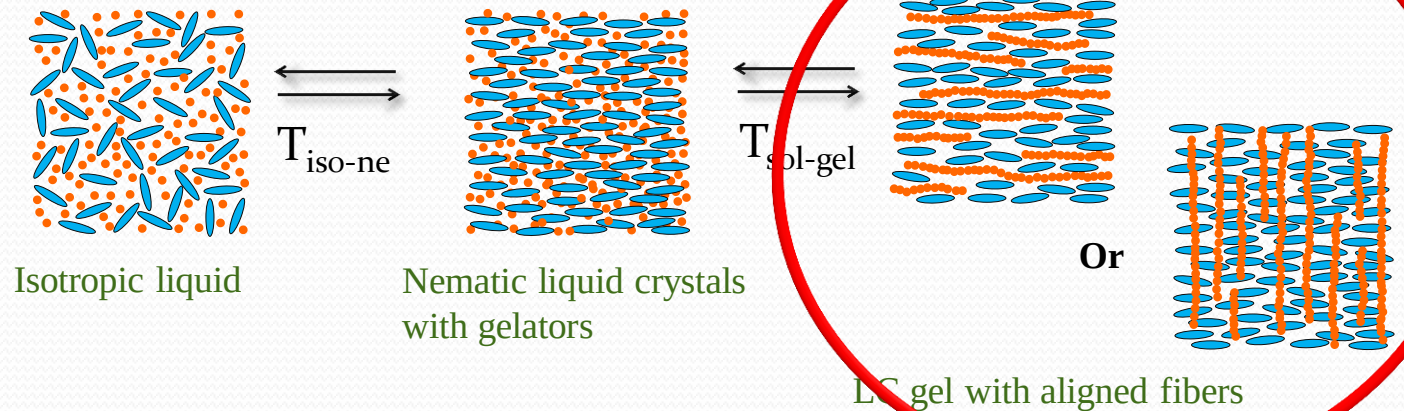


Phase-Separated Structures of LC Gel

(a) Type I: $T_{\text{sol-gel}} > T_{\text{iso-ne}}$



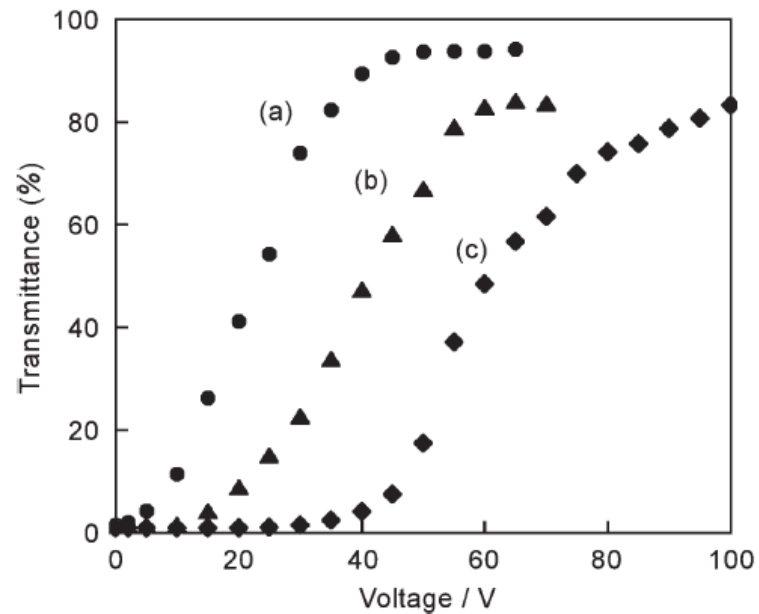
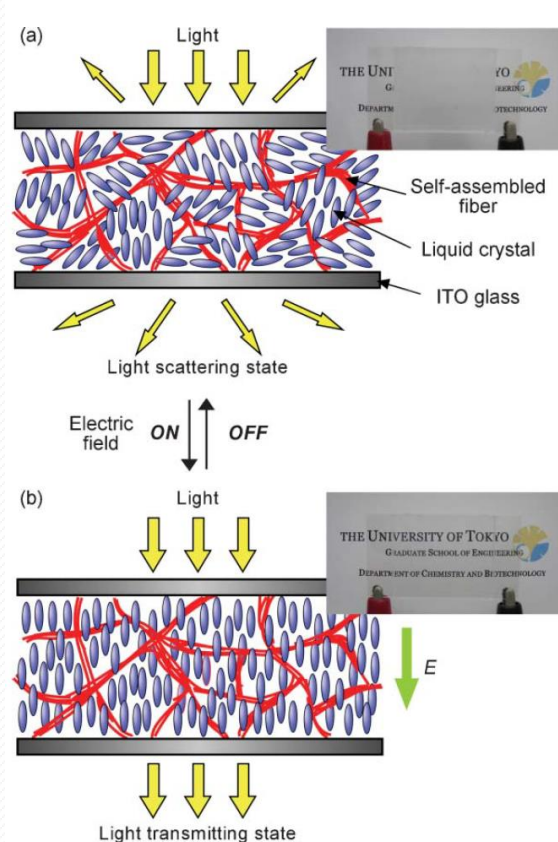
(b) Type II: $T_{\text{iso-ne}} > T_{\text{sol-gel}}$



Temperature

Previous Study - I

I. Normal mode



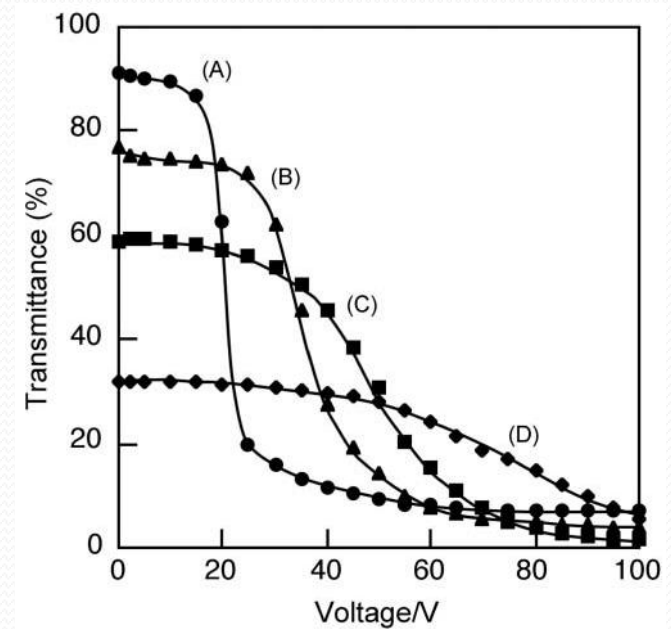
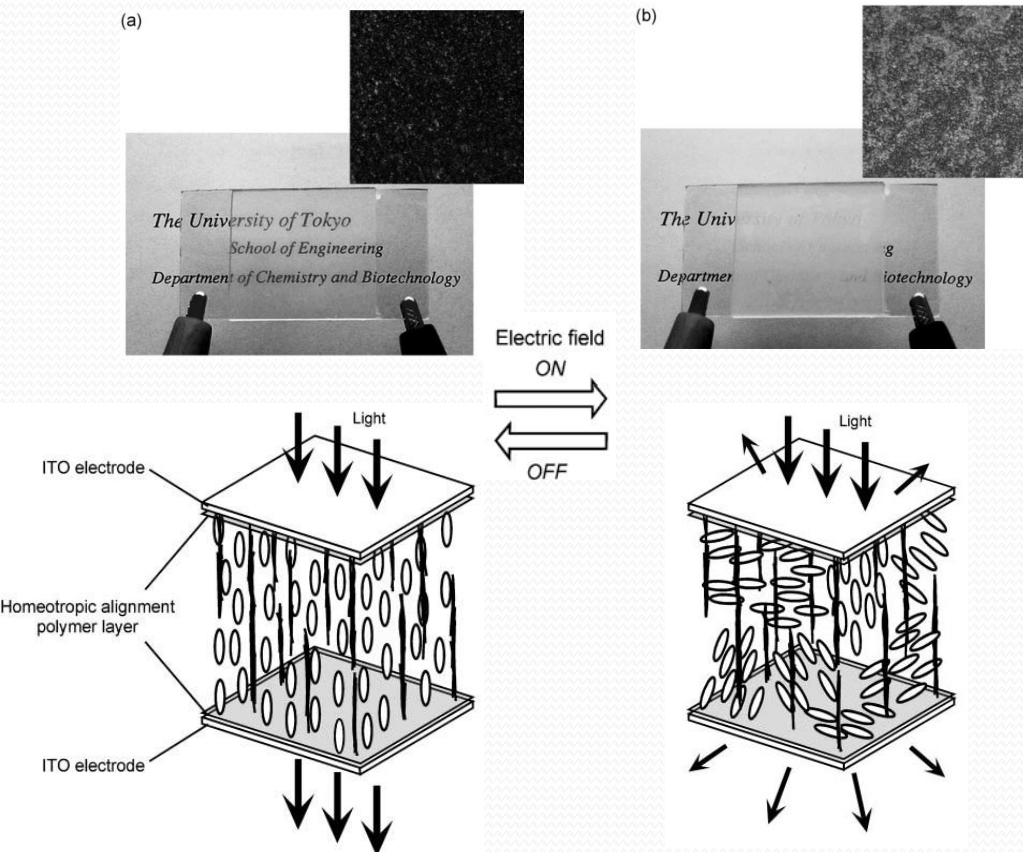
For (A) :
 Operating voltage ~ 40 V
 Contrast ratio ~ 70

N. Mizoshita et al., *J. Mater. Chem.*, **12**, 2197-2201 (2002)

T. Kato et al., *Chem. Soc. Rev.*, **36**, 1857-1867 (2007)

Previous Study - II

II. Reverse mode



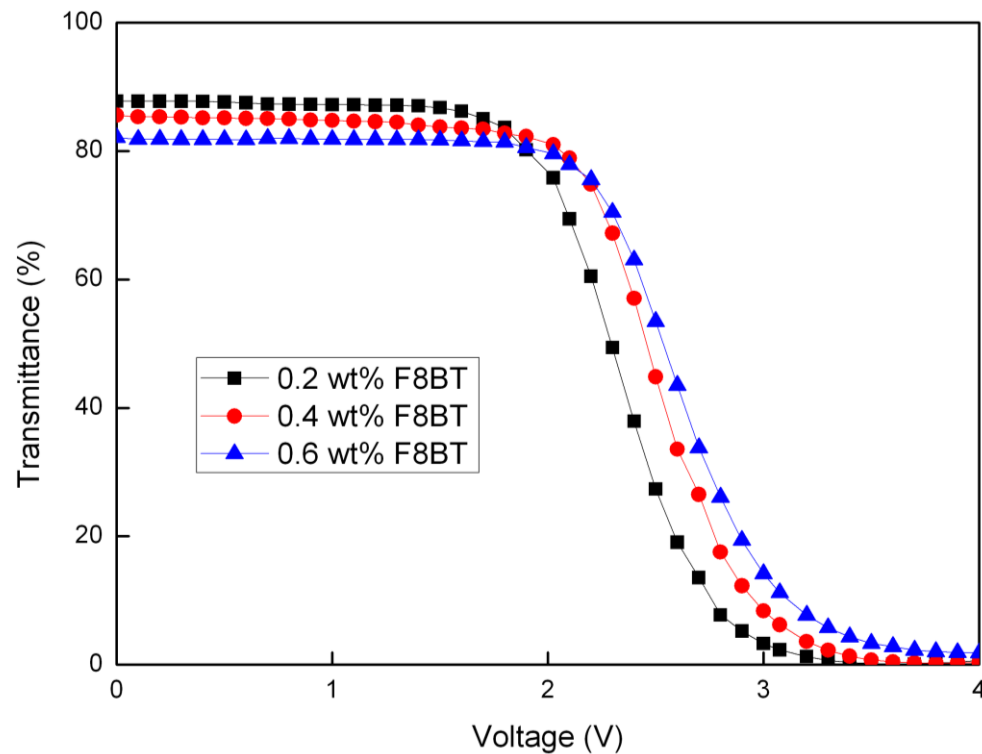
For (A) :

Operating voltage ~ 70 V

Contrast ratio ~ 20



Supramolecular Liquid-Crystal Gels



Concentration of F8BT in E7	V _{op}	CR
0.2 wt%	3.5 V	1170
0.4 wt%	3.8 V	355
0.6 wt%	4.2 V	44

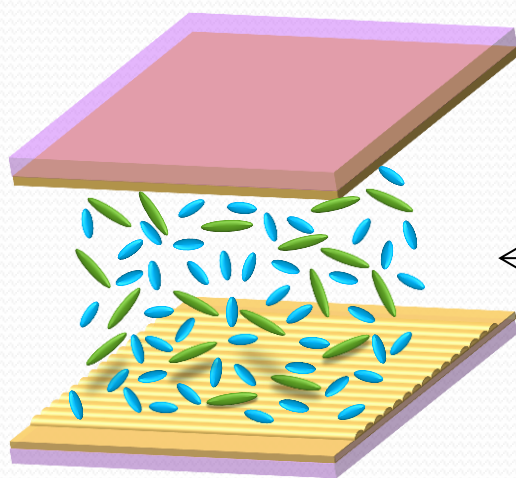
Wave Form: 1kHz, square wave.



Anisotropic Fibers

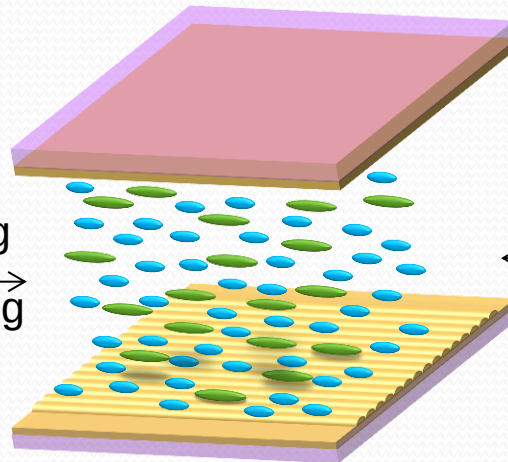
- liquid crystal
- F8BT molecule

High Contrast Ratio
Low Driving Voltage



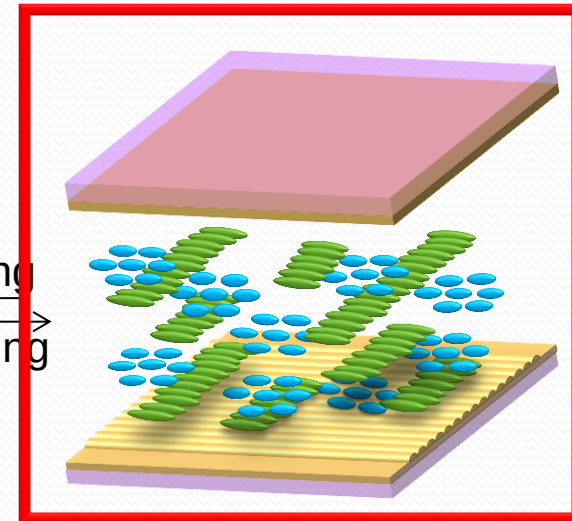
Isotropic Liquid

Heating
Cooling



Nematic LC

Heating
Cooling



Nematic LC
Gel

Temperature



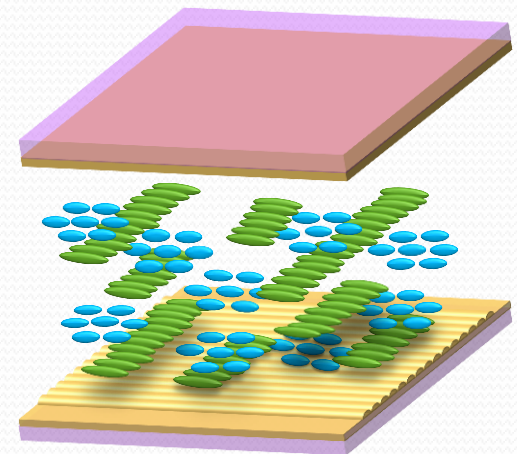
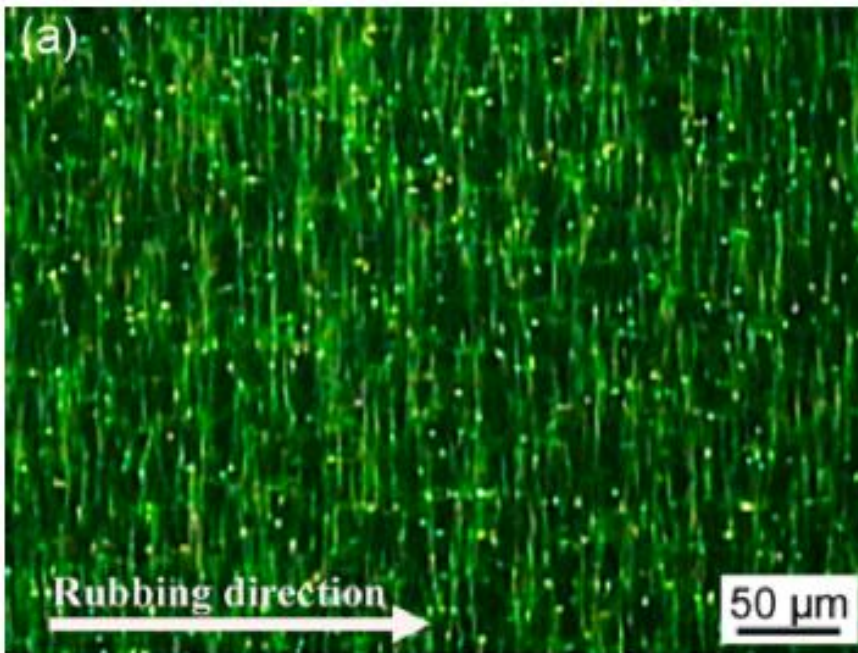
Enhancement of Contrast Ratio

20~70 $\rightarrow$ 1170

Why?



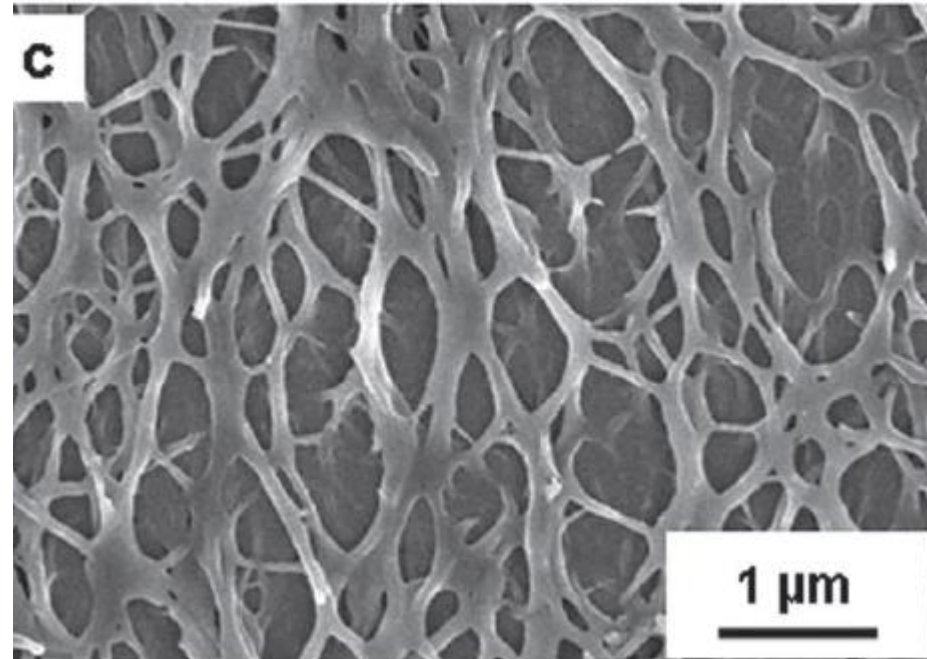
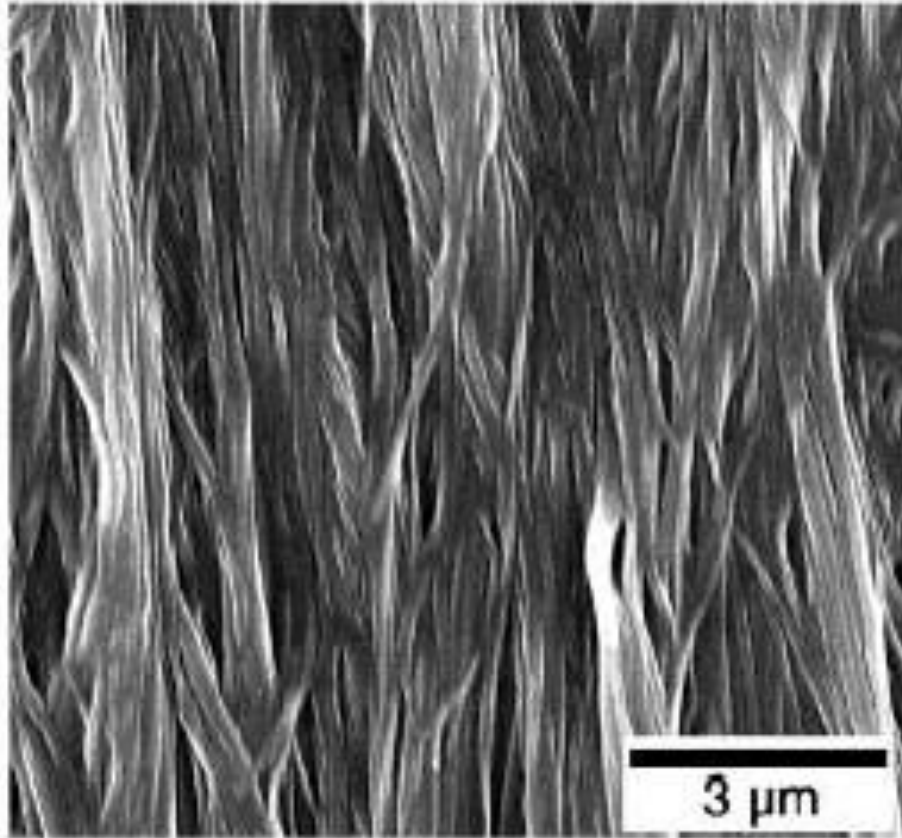
Anisotropic π -Conjugated Fibers



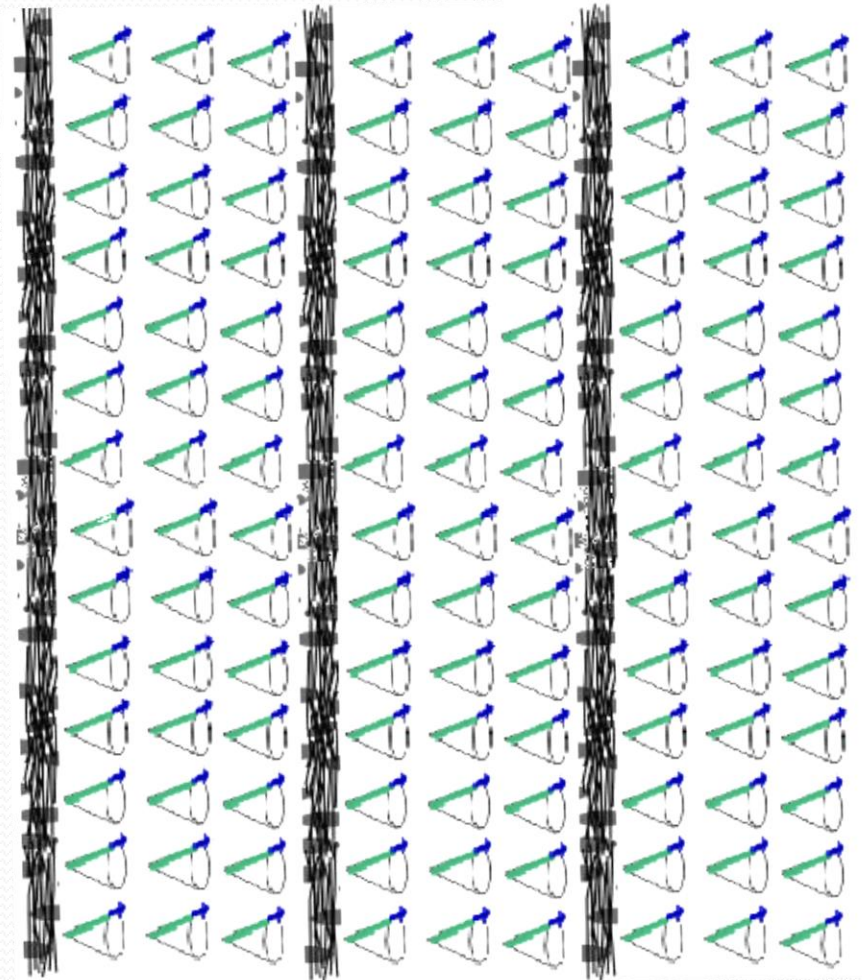
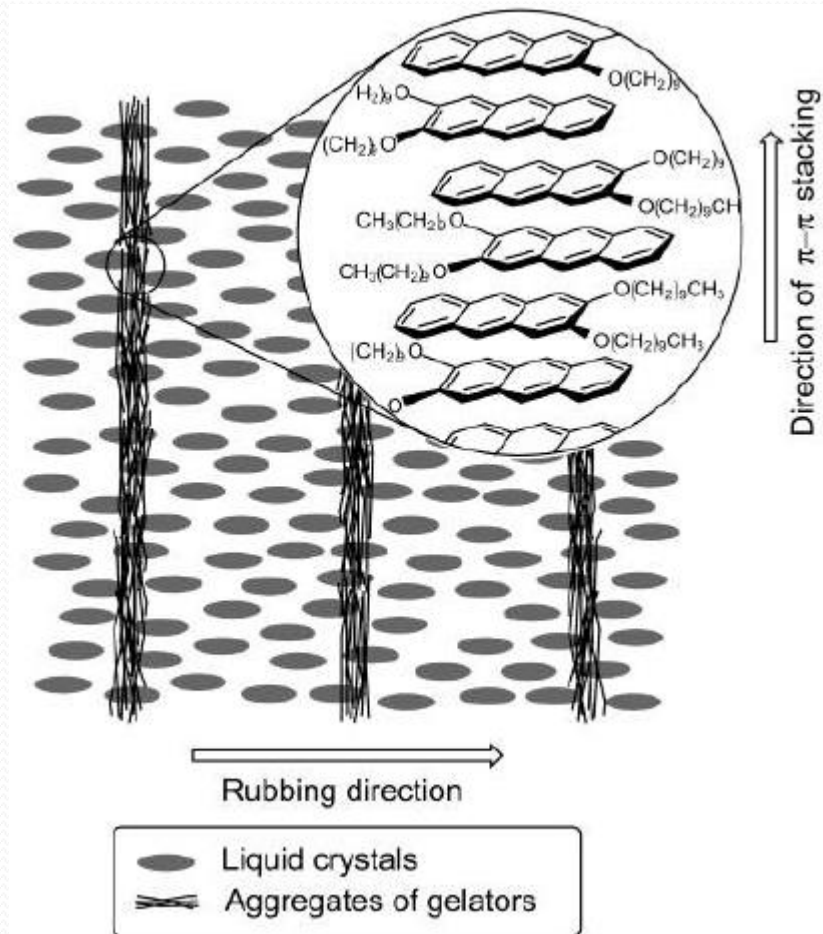
Nematic LC Gel



Anisotropic π -Conjugated Fibers



Anisotropic π -Conjugated Fibers





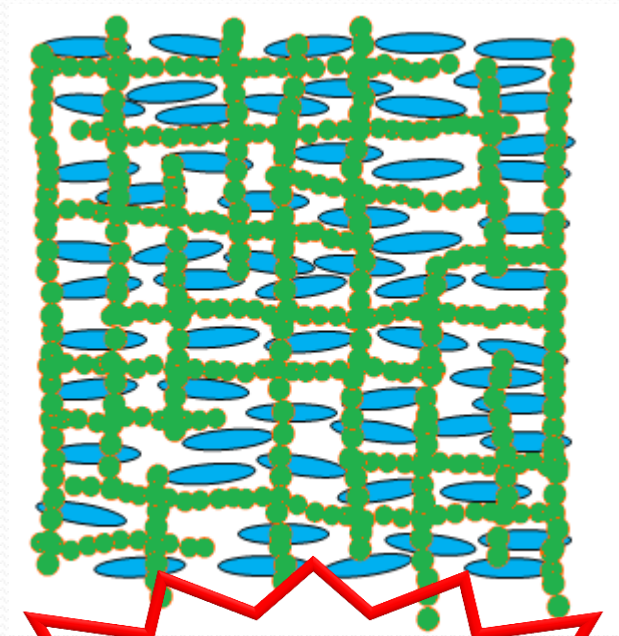
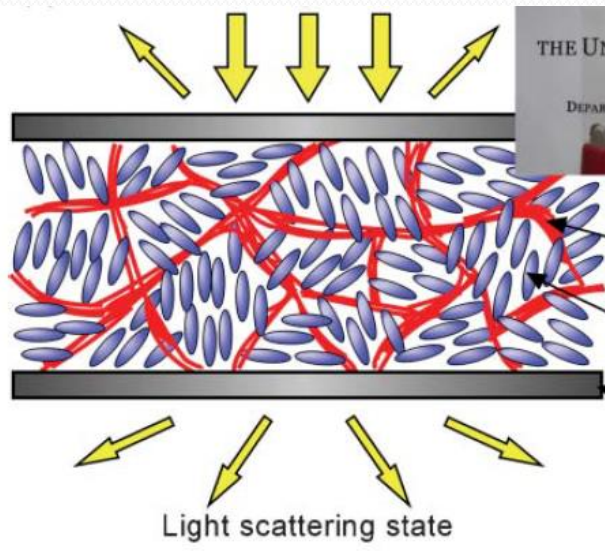
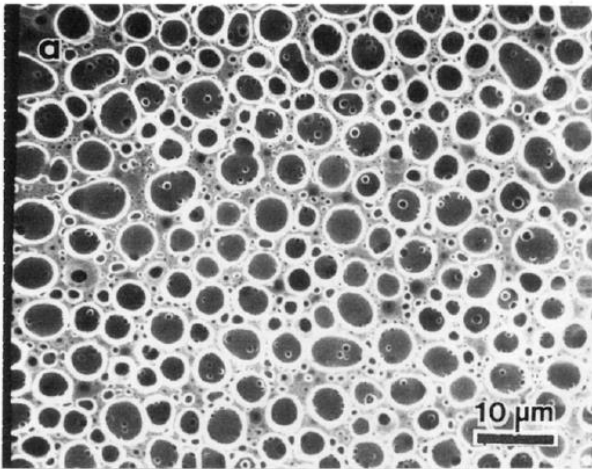
Reduction of Driving Voltage

$40 \sim 70 \text{ V} \rightarrow 3.5 \text{ V}$

Why?



Encapsulation by π -Conjugated Fibers



Flexible Display !

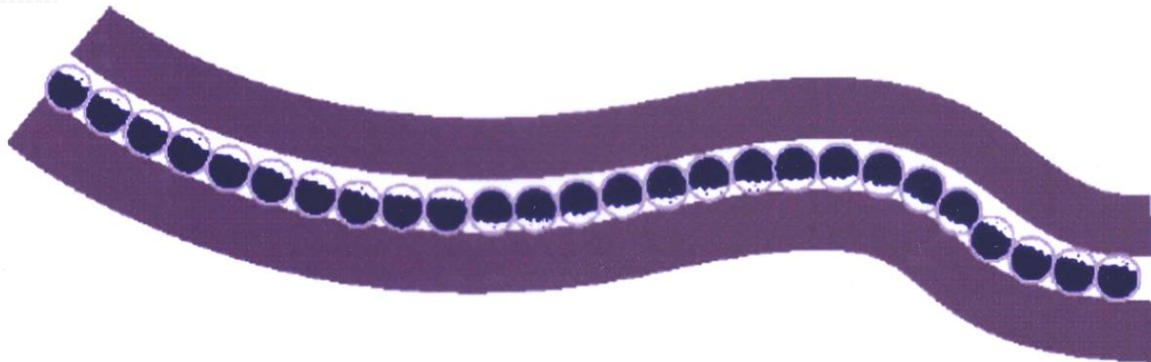
Encapsulated display media



PDLC

rotating ball

*microencapsulated
electrophoretic*



- Printing onto arbitrary surfaces
- Flexibility of finished device





Encapsulated display media

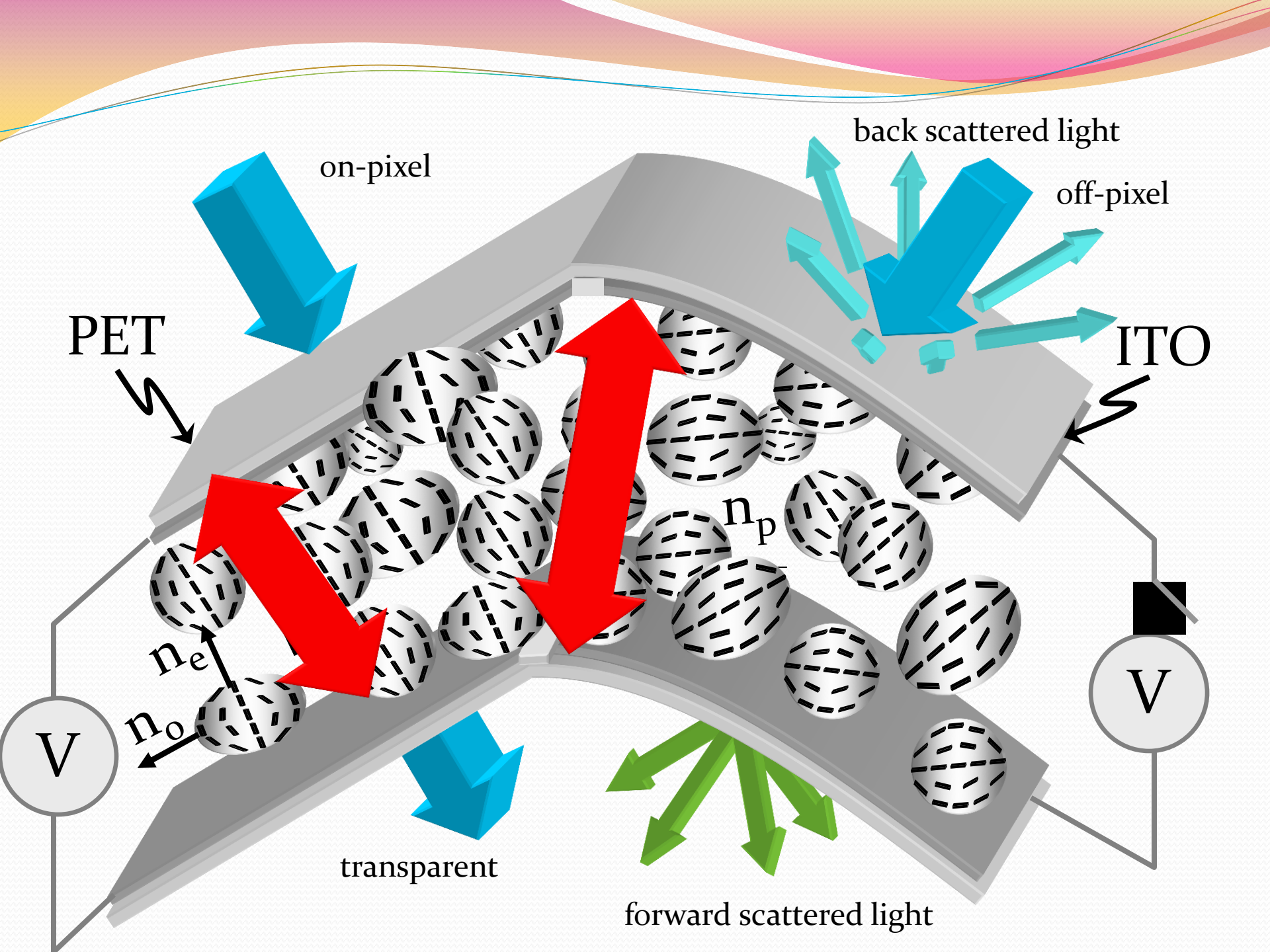
DISADVANTAGES:

E-Ink

- Stability of suspension unclear
- Higher drive voltage than available drivers
- Slow switching speed
- Complex chemistry

Gyricon

- High voltage
- needs active matrix
- sticky balls



新穎共軛超分子膠囊化技術

Fast Switching

Good Alignment

Flexible

LC Flexible Display!



- Conformable display
- Display of clothing
- Wrist display



新穎共軛超分子膠囊化技術

- 改善現有顯示器反應時間
- 解決現有顯示器殘影現象



3D 裸眼顯示器！