

LCD結構解析與實體拆解

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光電所 - 葉志傑

製造所 - 李朝修

光電所 - 吳紹銘

LCD結構解析大綱

- TFT LCD 原理與結構篇
 - 動作原理
 - 實體解剖
- TFT & CF 功能與製程篇
 - Thin Film Transistor
 - Color Filter
- LCD 背光模組篇
 - 結構
 - 技術
- 結論

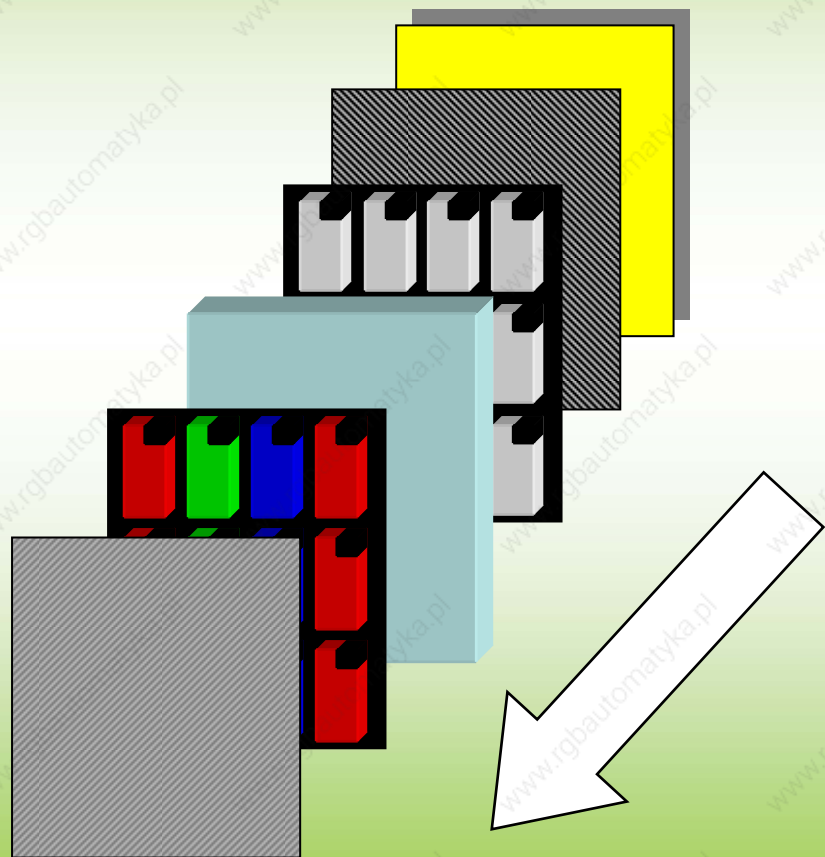
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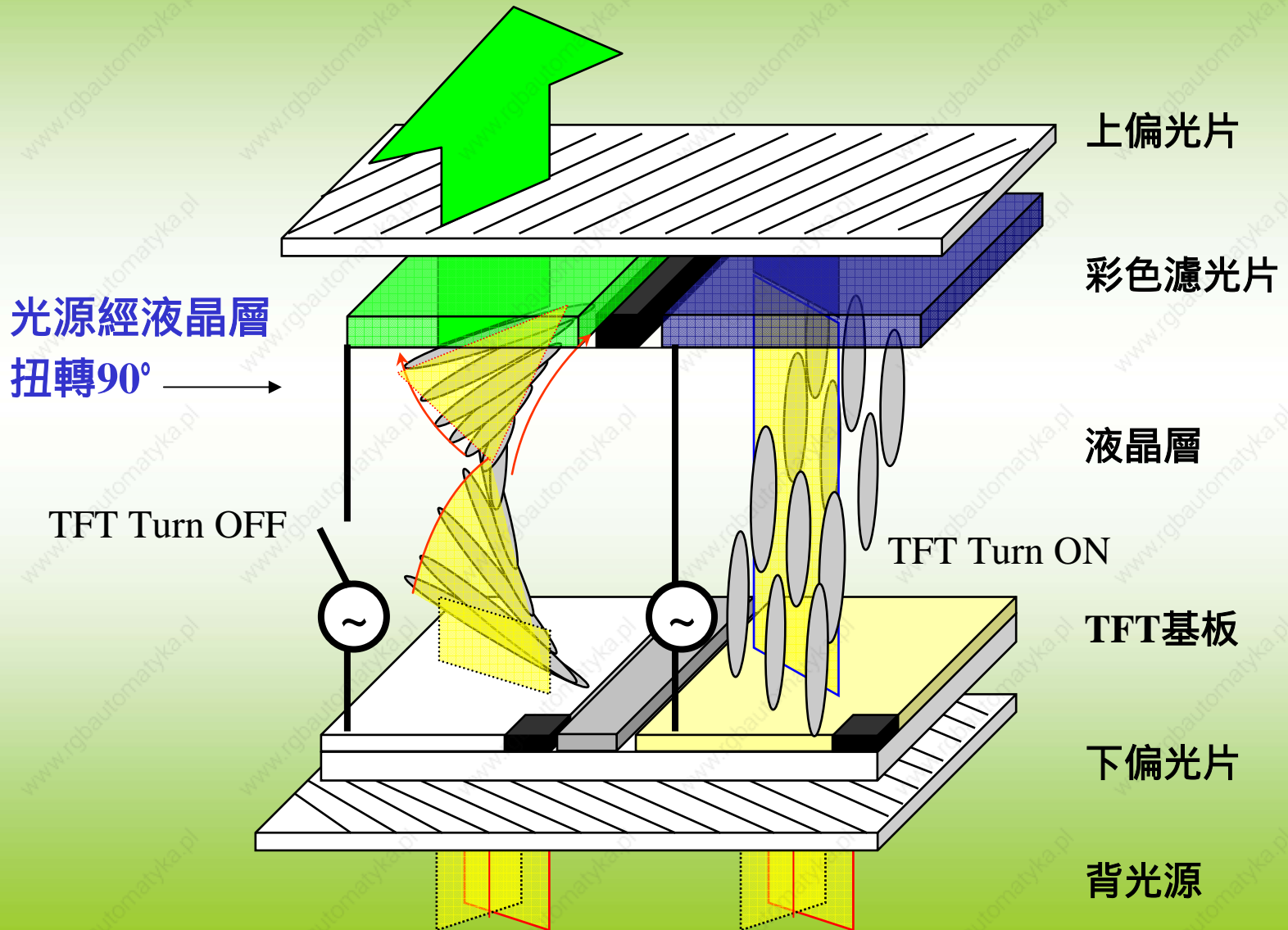
TFT-LCD產品的基本構成元件

- **基本構造**

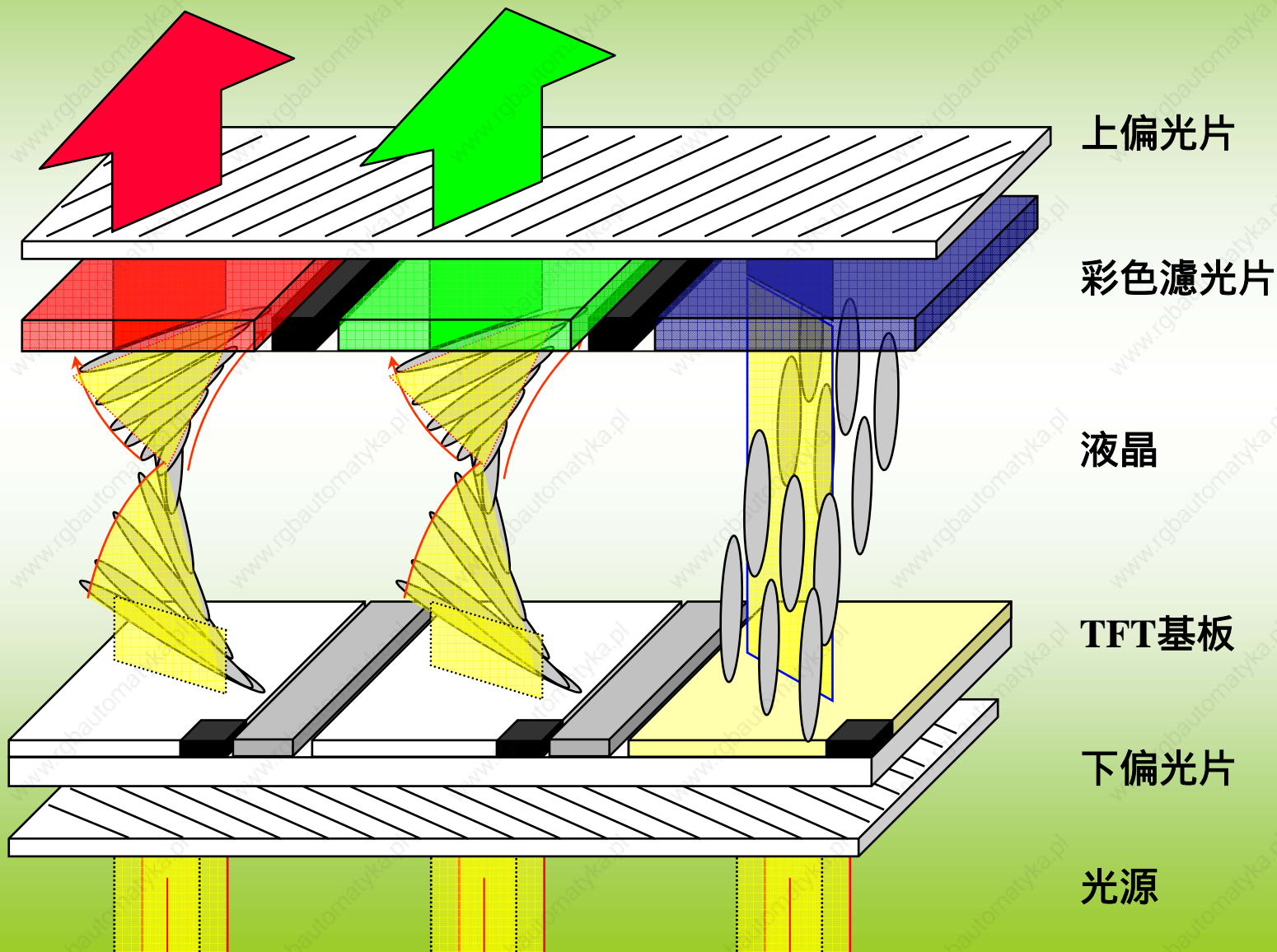
- 背光板(BACK LIGHT)
- 下偏光片(DOWN POLARIZER)
- 薄膜基板(TFT SUBSTRATE)
- 液晶(LIQUID CRYSTAL)
- 彩色濾光片(COLOR FILTER)
- 上偏光片(UP POLARIZER)



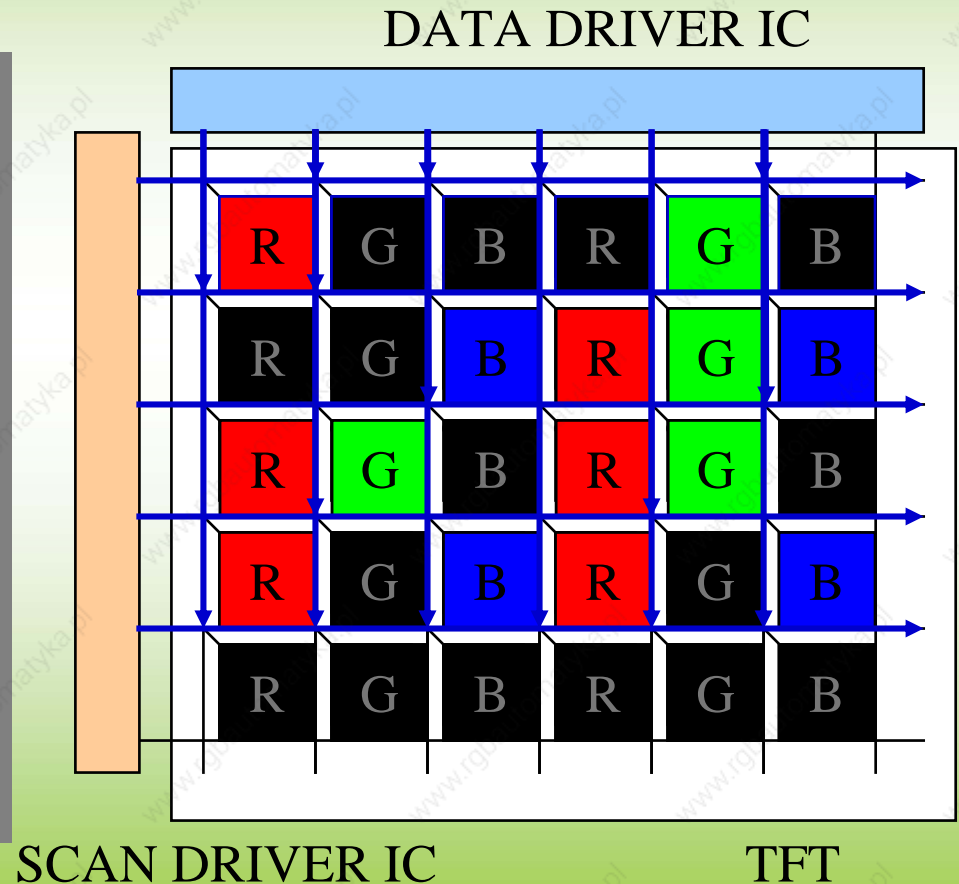
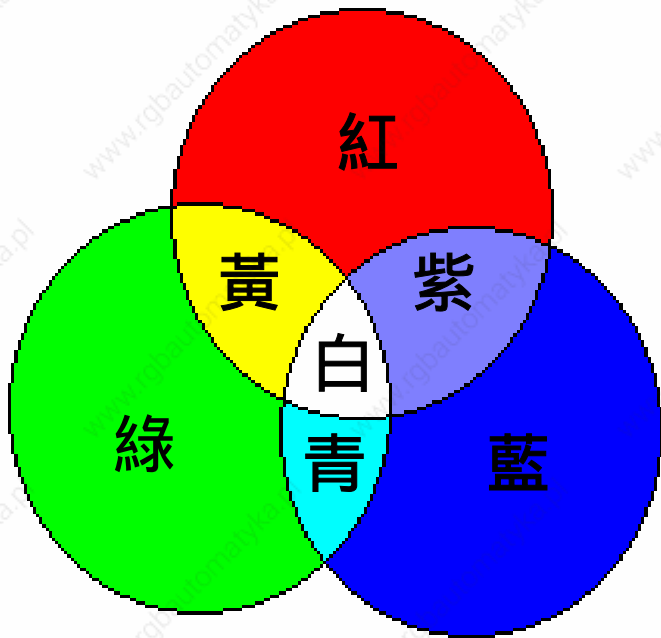
TFT-LCD的顯示原理 (一)



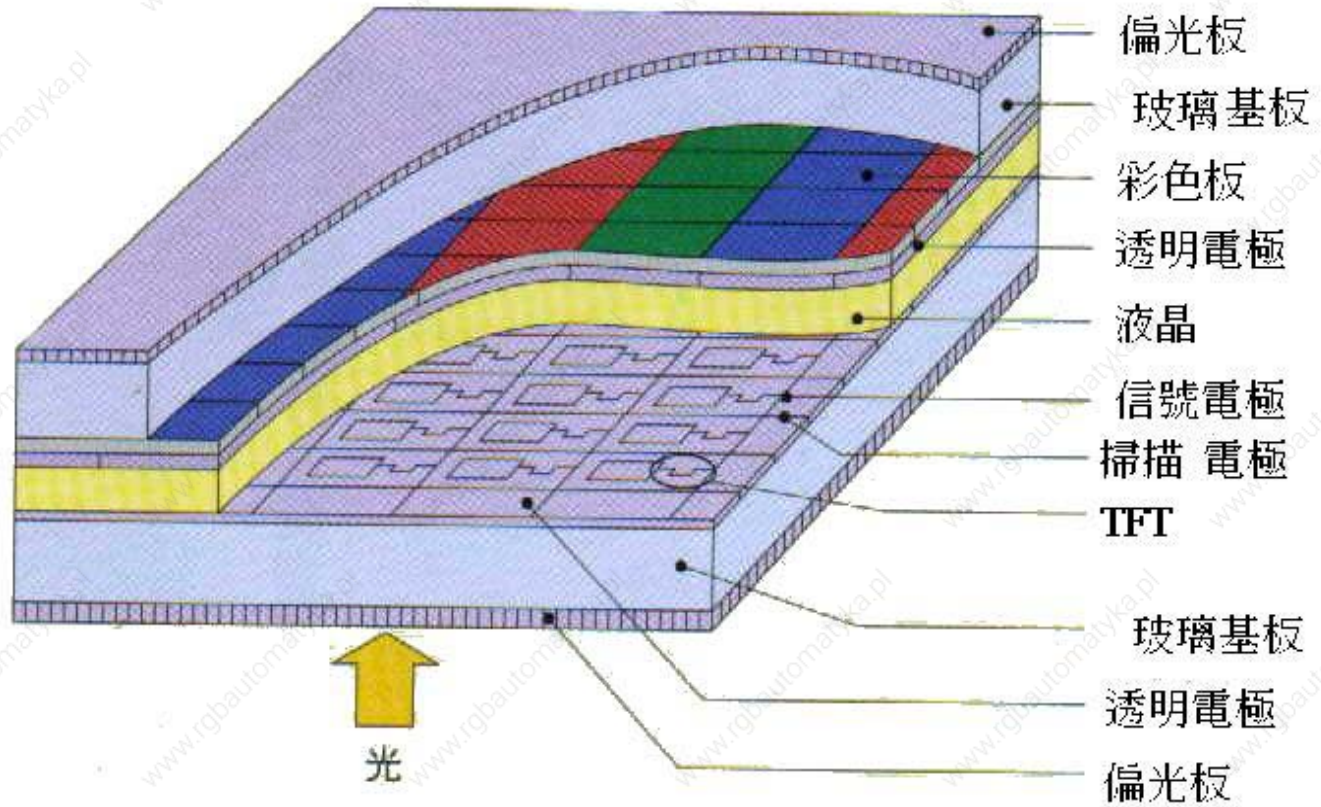
TFT-LCD的顯示原理 (二)



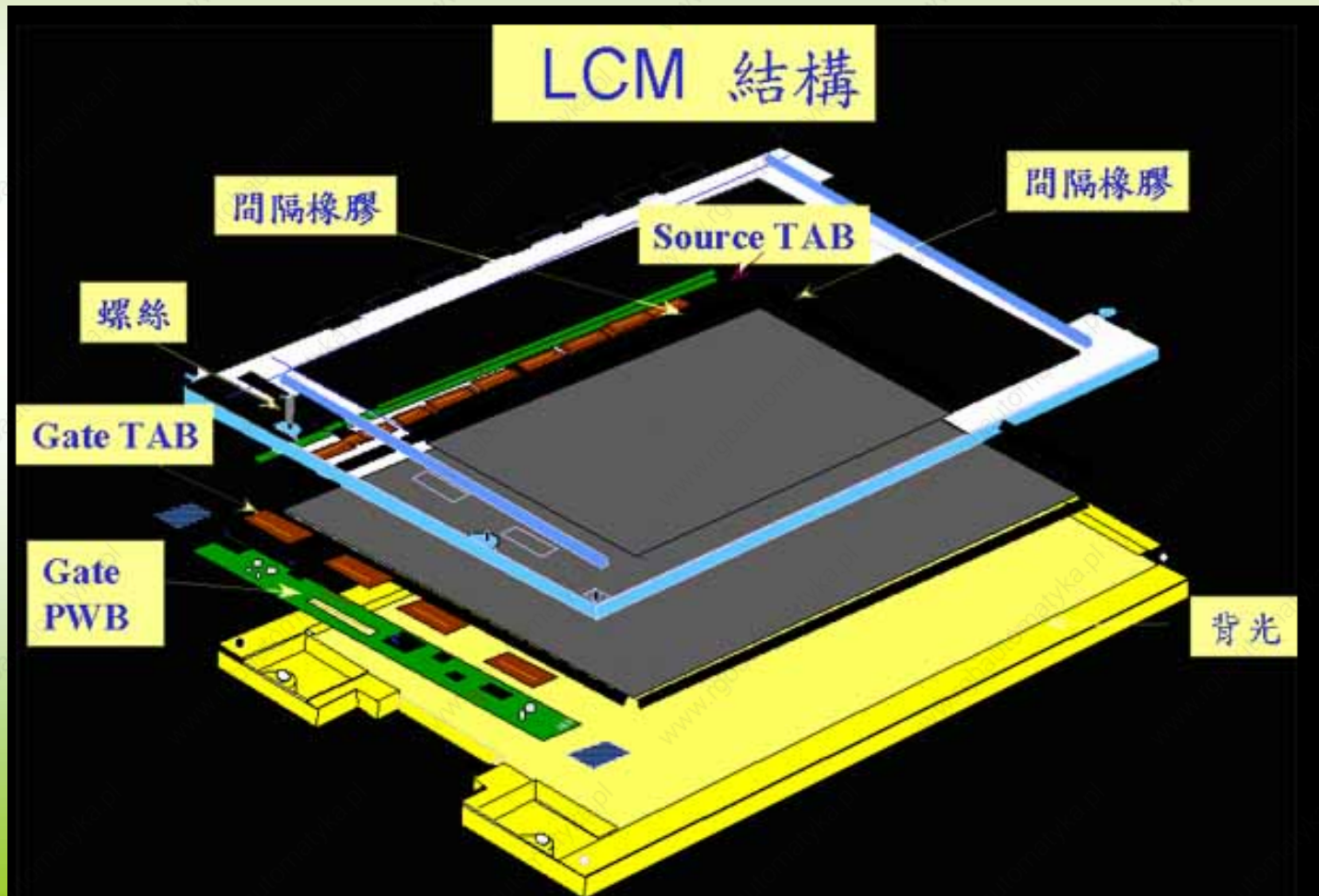
TFT-LCD 的驅動原理



面板結構圖



LCD面板機械結構



待分解LCD螢幕

- 螢幕



面板規格說明

- Vendor : SANYO (MXS121022010)
- Display type : 12.1" color TFT LCD
- Max. resolution : 800 x 600
- Max. colors : 262K
- Luminance (brightness) : 200 cd/m²
- Viewing angle : 90°(H), 40°(V)
- LCD MTBF : 50,000 hrs
- Backlight MTBF : 20,000 hrs
- Interface: VGA
- Operating temperature : 0 ~ 50°C

LCD模組寫真

- 面板正面



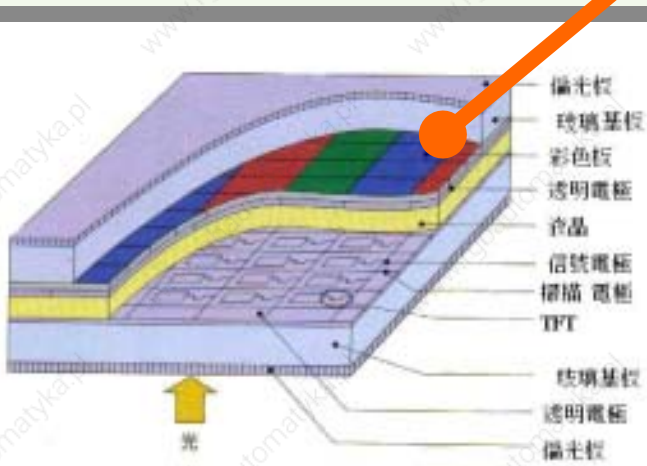
LCD模組寫真

- 面板正面



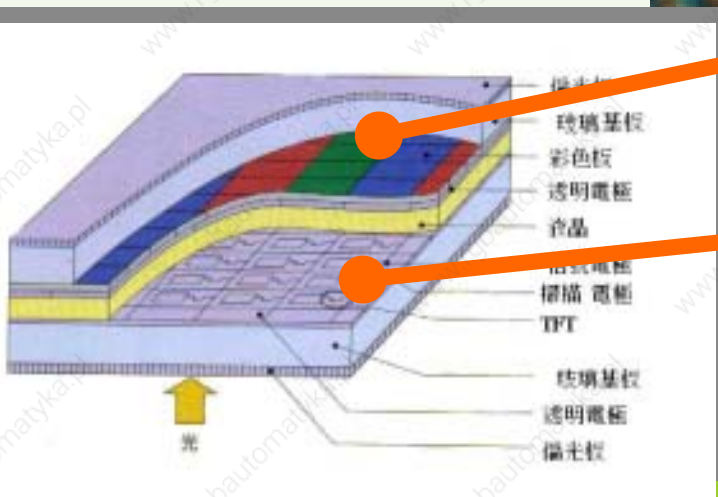
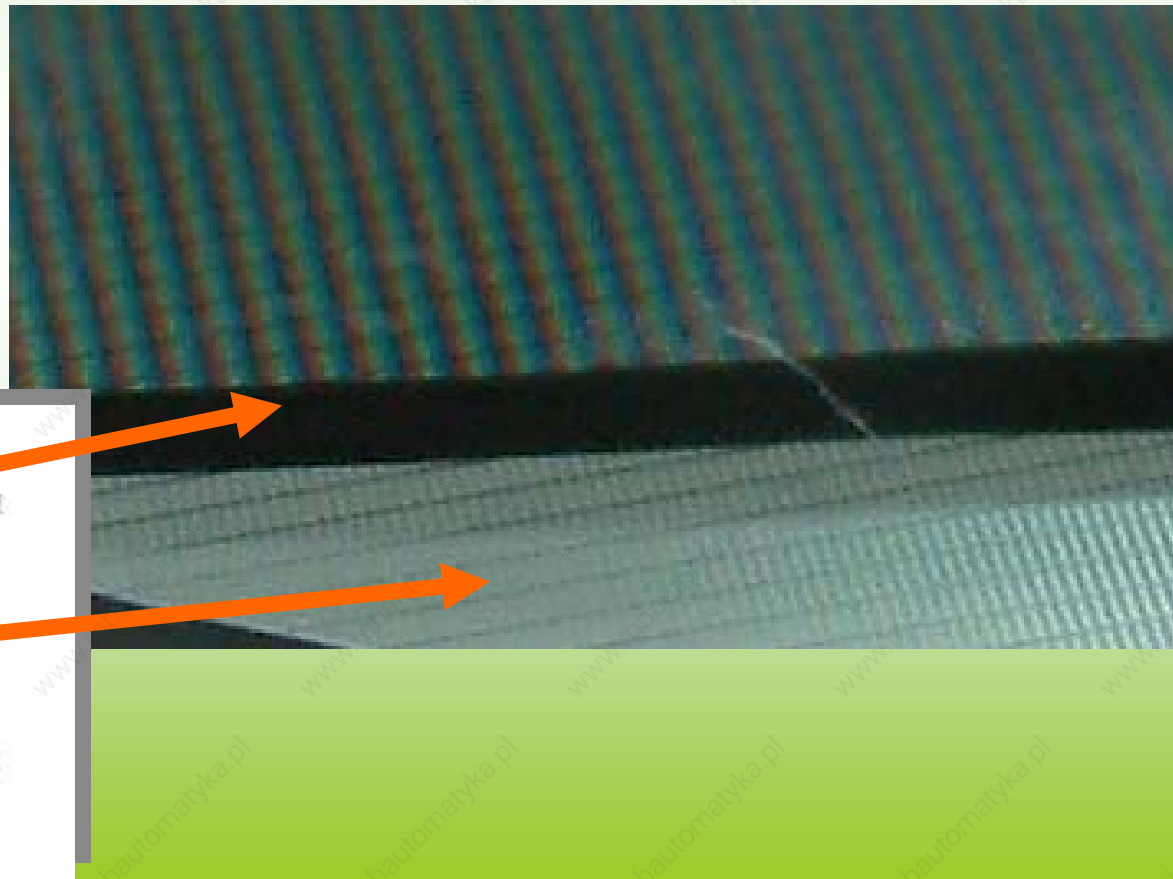
LCD模組寫真

- 近看的面板表面

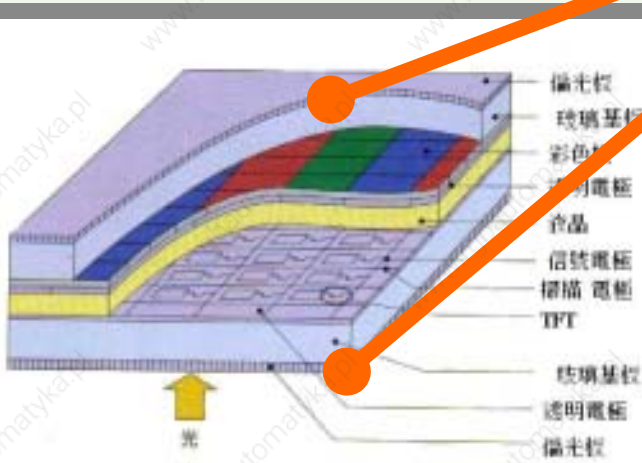
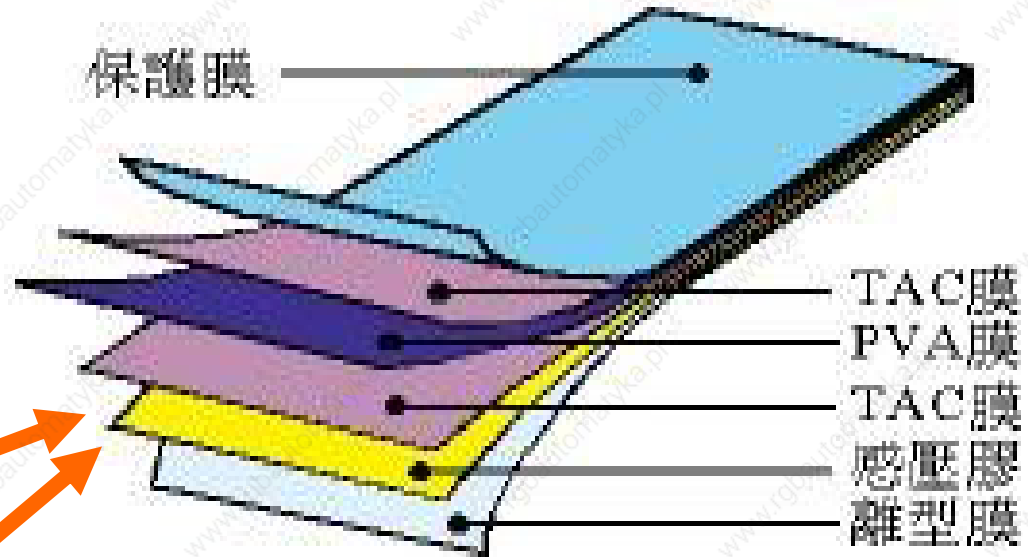


LCD模組寫真

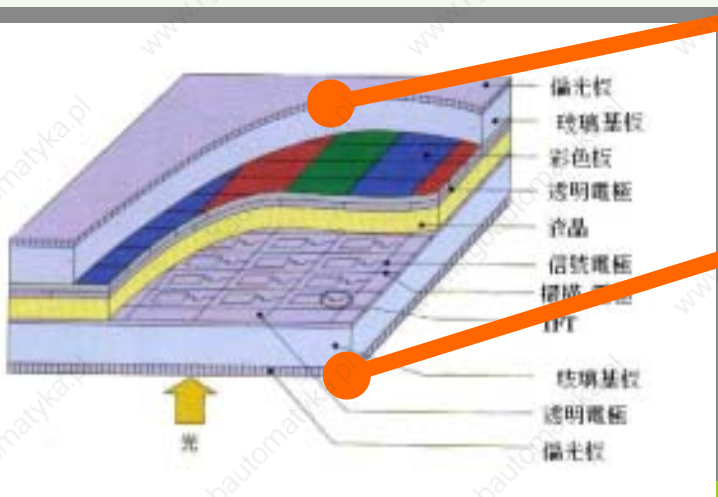
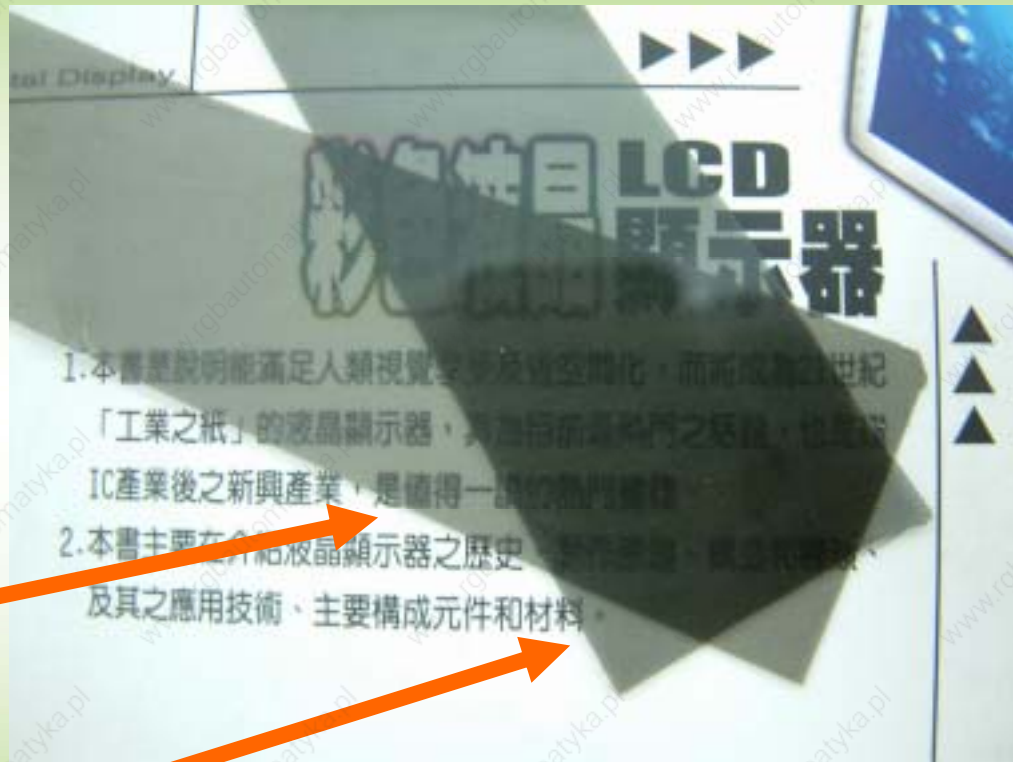
- 破壞後之面板



偏光板結構圖



偏光板寫真



LCD模組動畫

- 偏光板

當上下兩片極化方向垂直時，
光線無法穿透（如影片所示）

VGA驅動電路模組

- 影像訊號電路



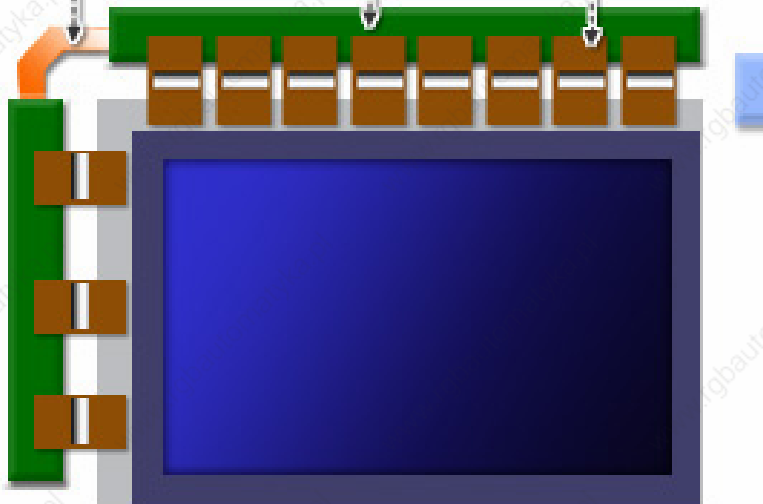
TFT驅動電路

Conventional Configuration

FPC

PCBA

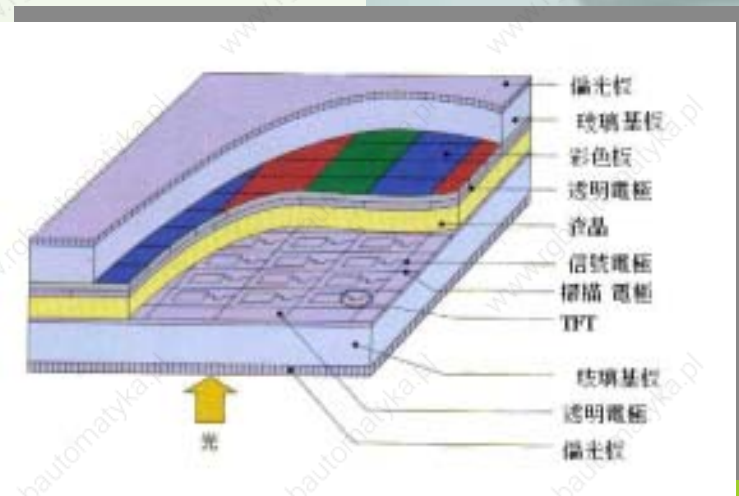
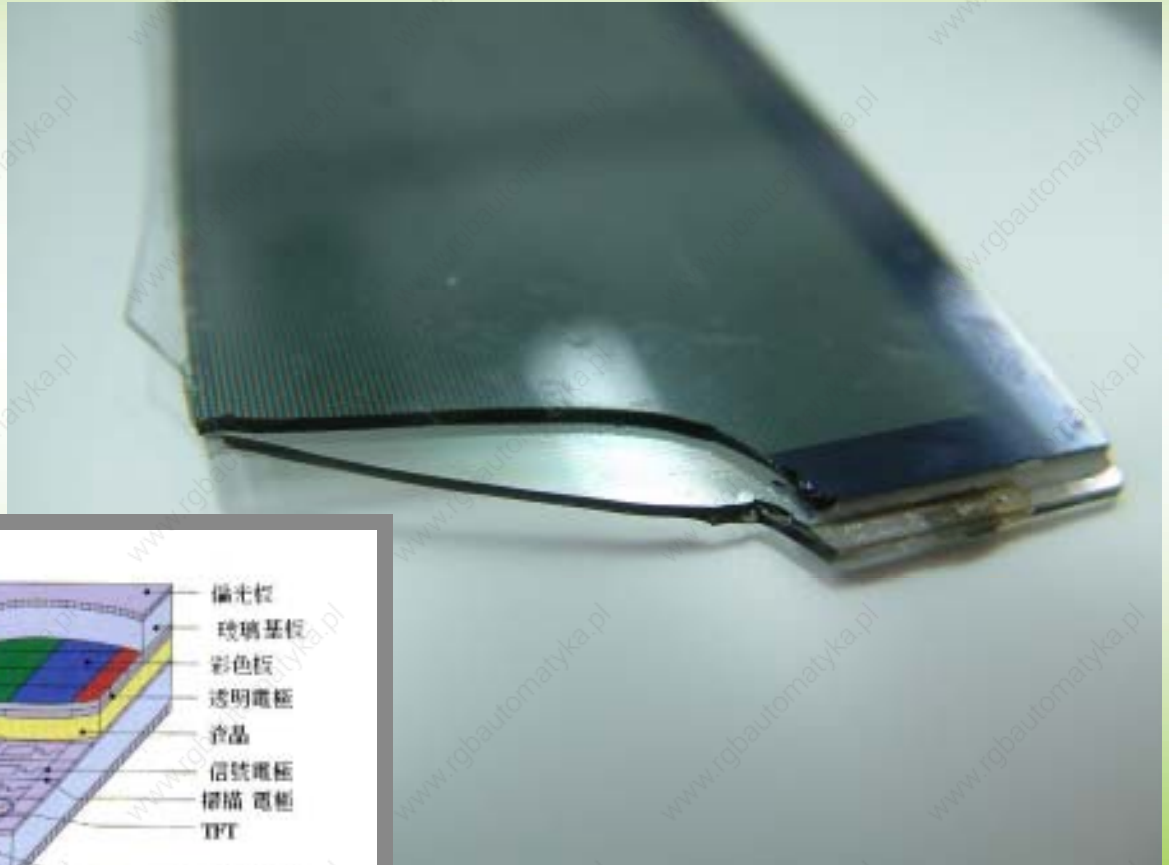
TAB



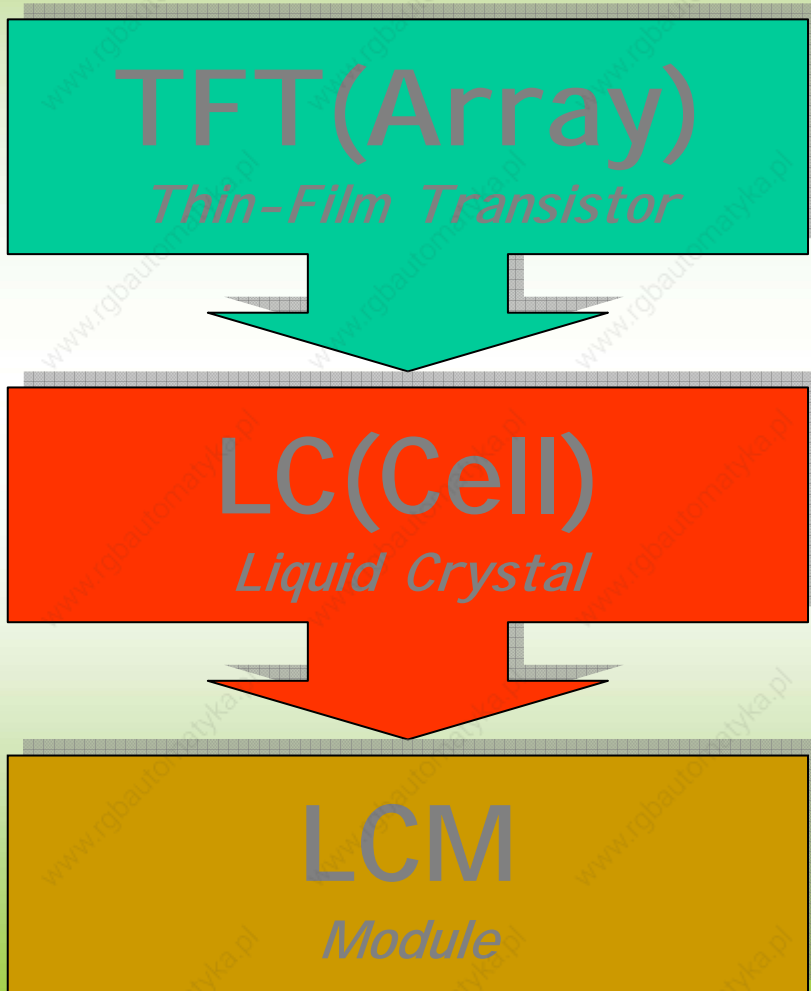
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LCD面板三明治寫真



LCD製造流程概述



**Array:電晶體
(矩形陣列)
TFT基板生成**

**Cell:面板生成
(Panel)**

**Module:產品模組
組裝**

前段Array

製程與半導

體製程相似，
但不同的是將
薄膜電晶體製
作於玻璃上，
而非矽晶圓上



Bare Glass
玻璃基板



CF(Color Filter)
彩色濾光片



5 Mask Process

- 成膜 **Film Deposition**
- 黃光 **Photo**
- 蝕刻 **Etching**
- 去光阻 **Stripping**

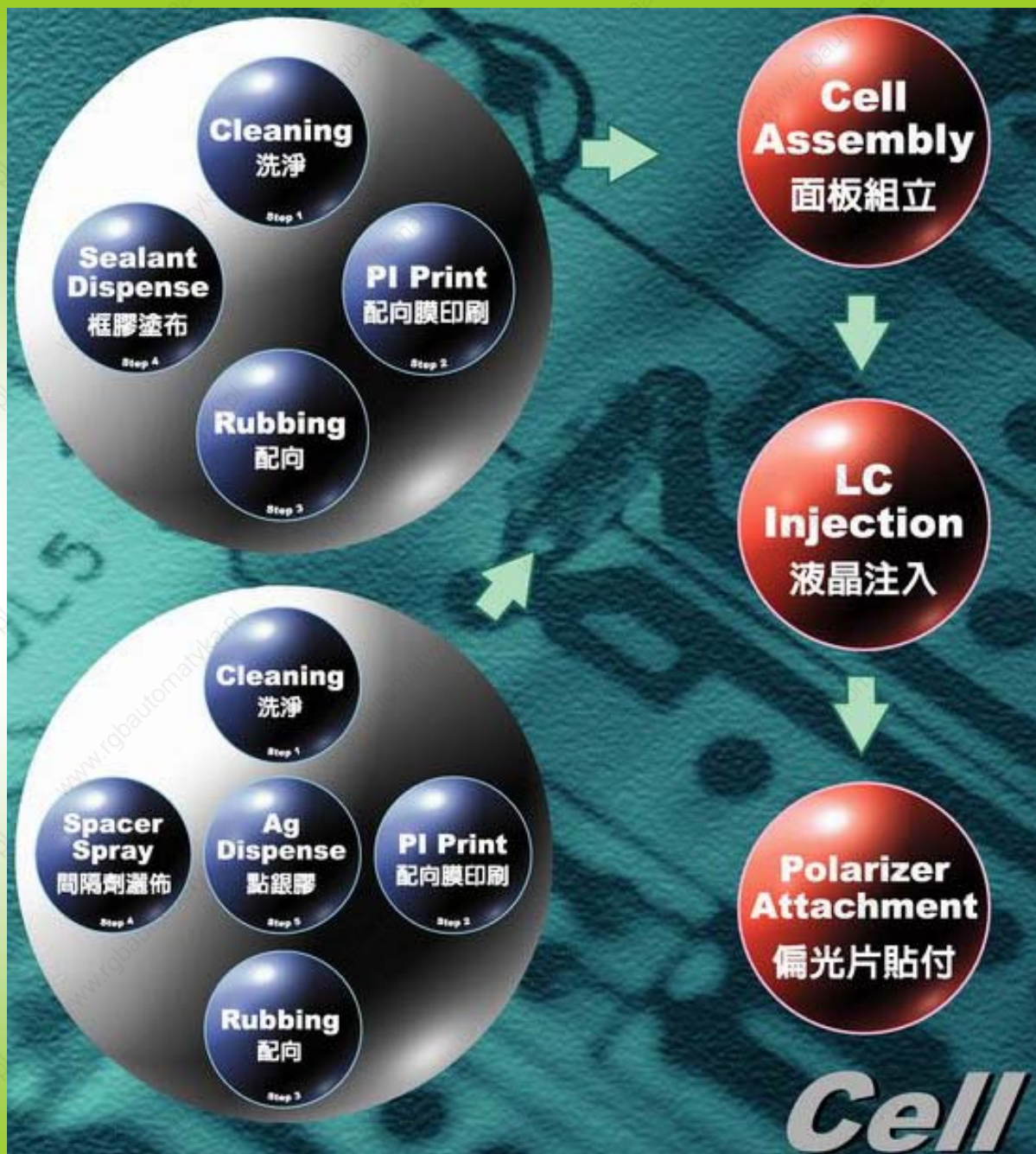


Array

中段Cell

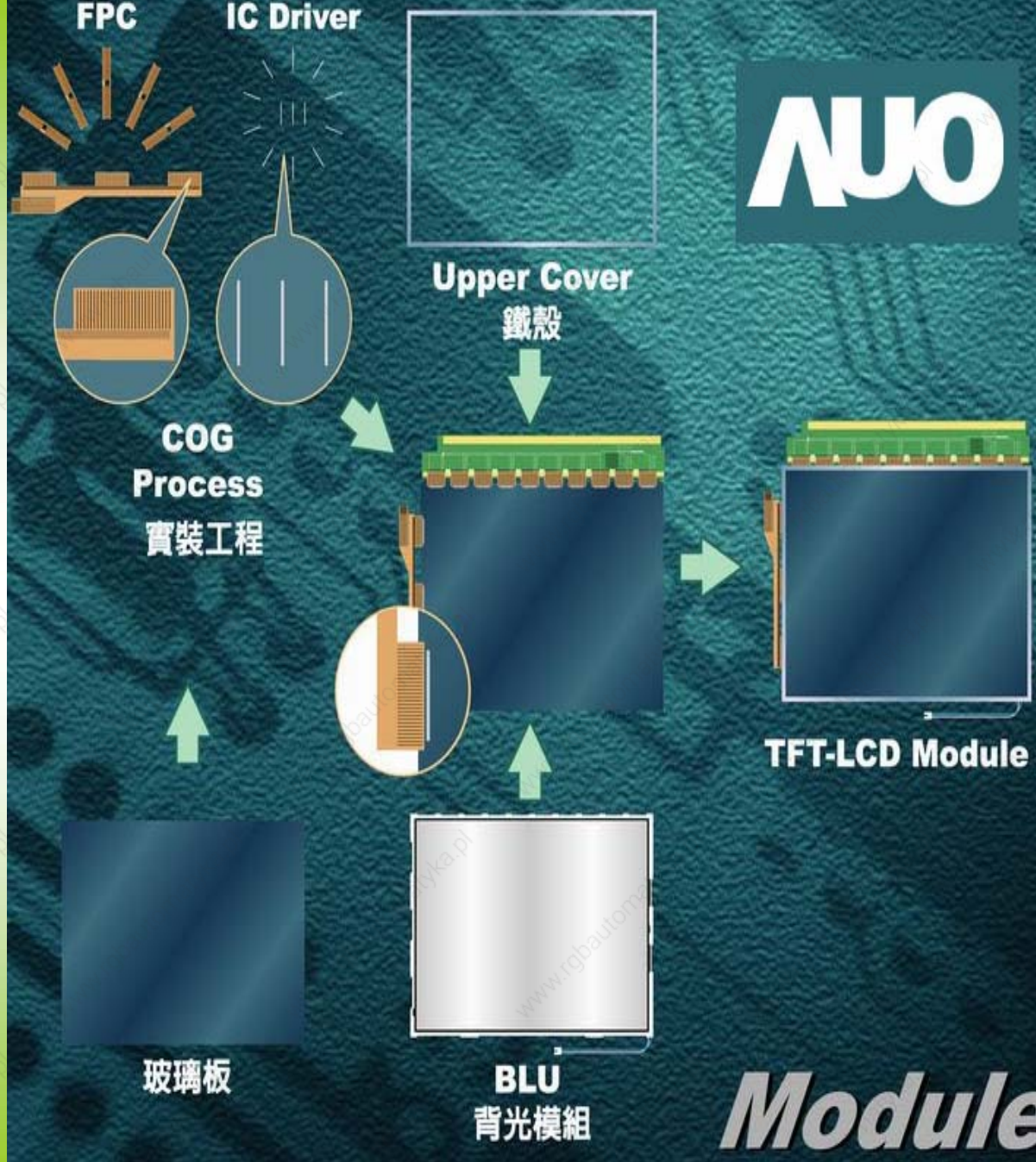
以前段

Array的玻璃為基板，與彩色濾光片的玻璃基板結合，並在兩片玻璃基板間灌入液晶(LC)。

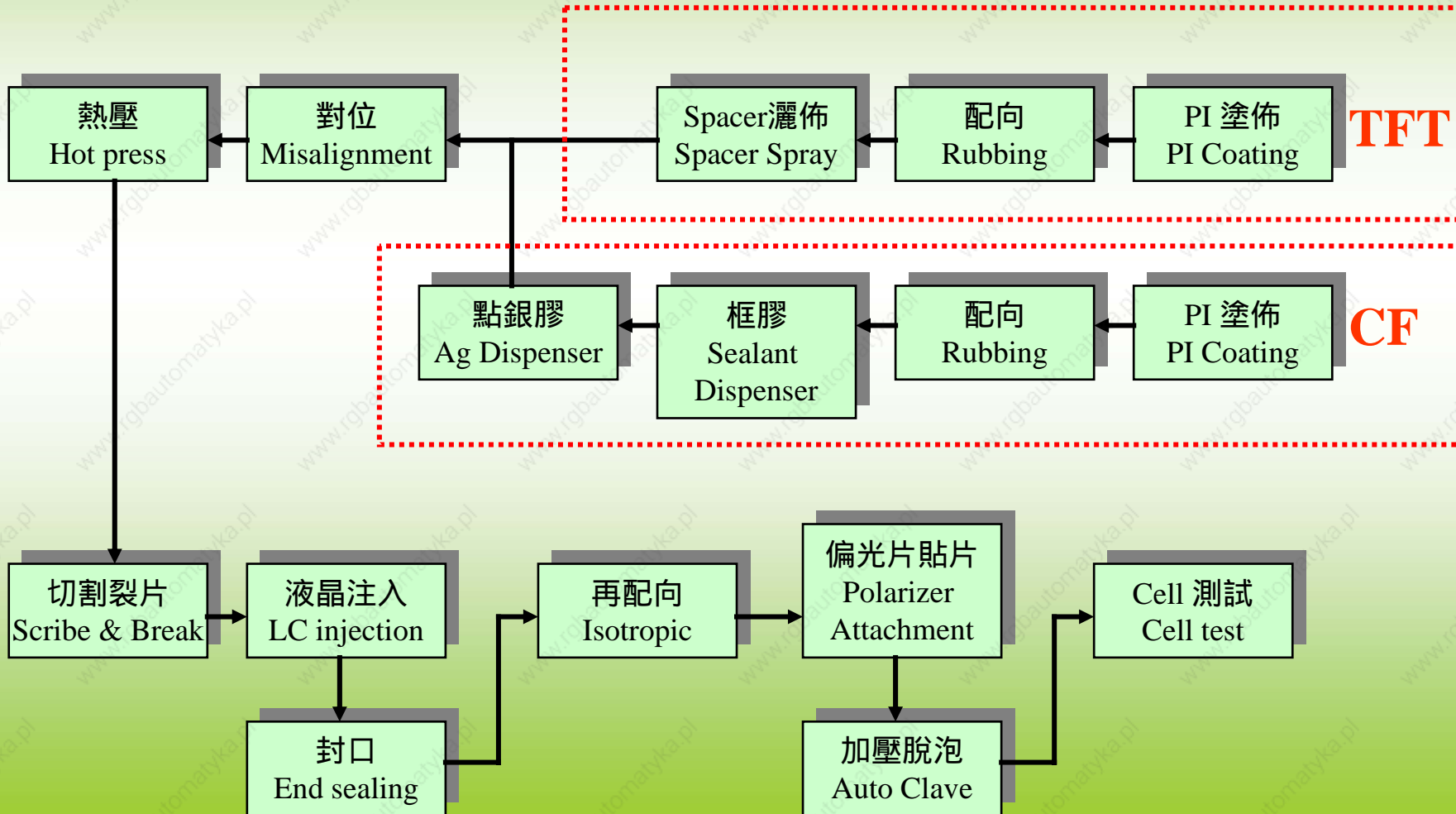


後段 Module Assembly

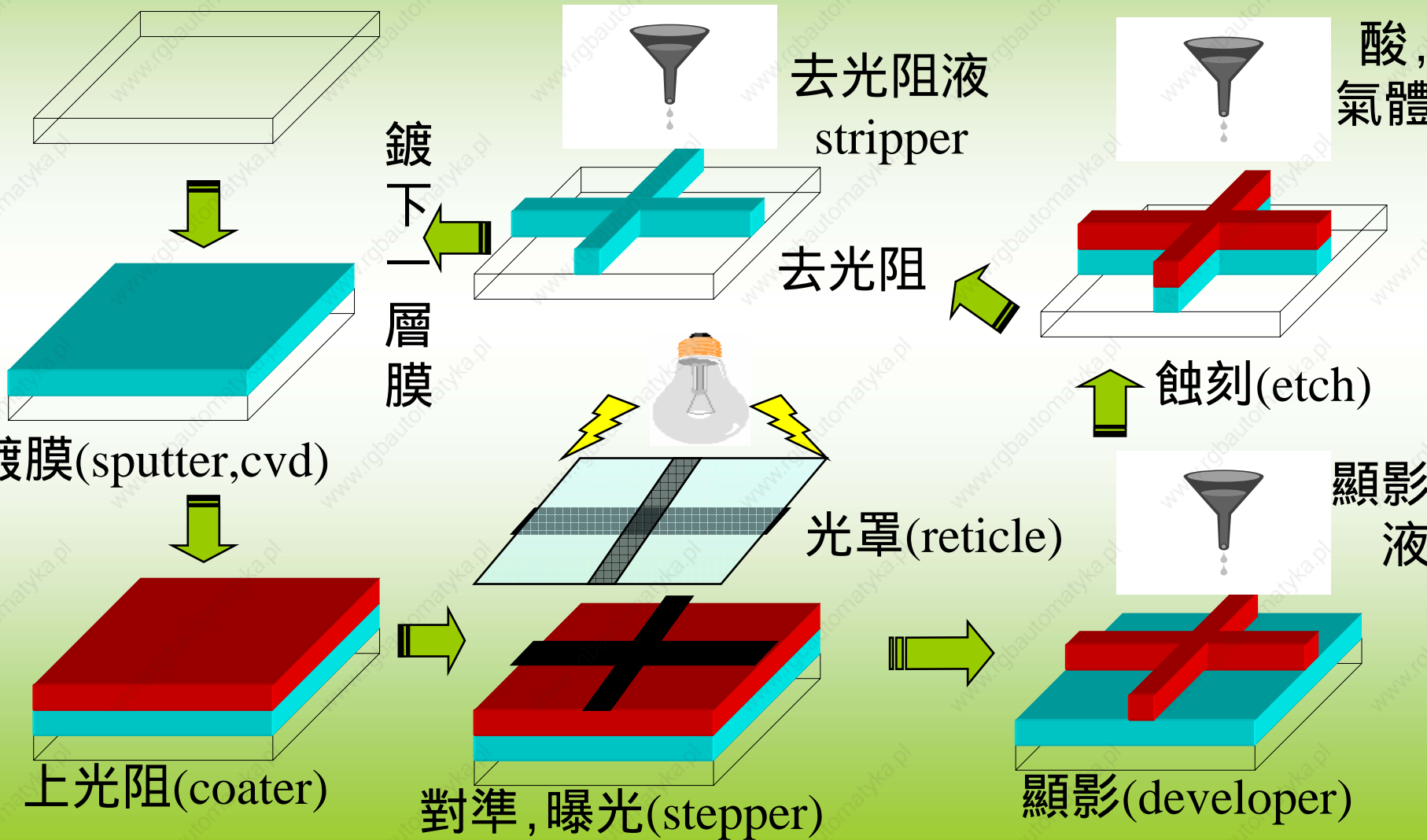
後段模組組裝製程是將Cell製程後的玻璃與其他如背光板、電路、外框等多種零組件組裝的生產作業



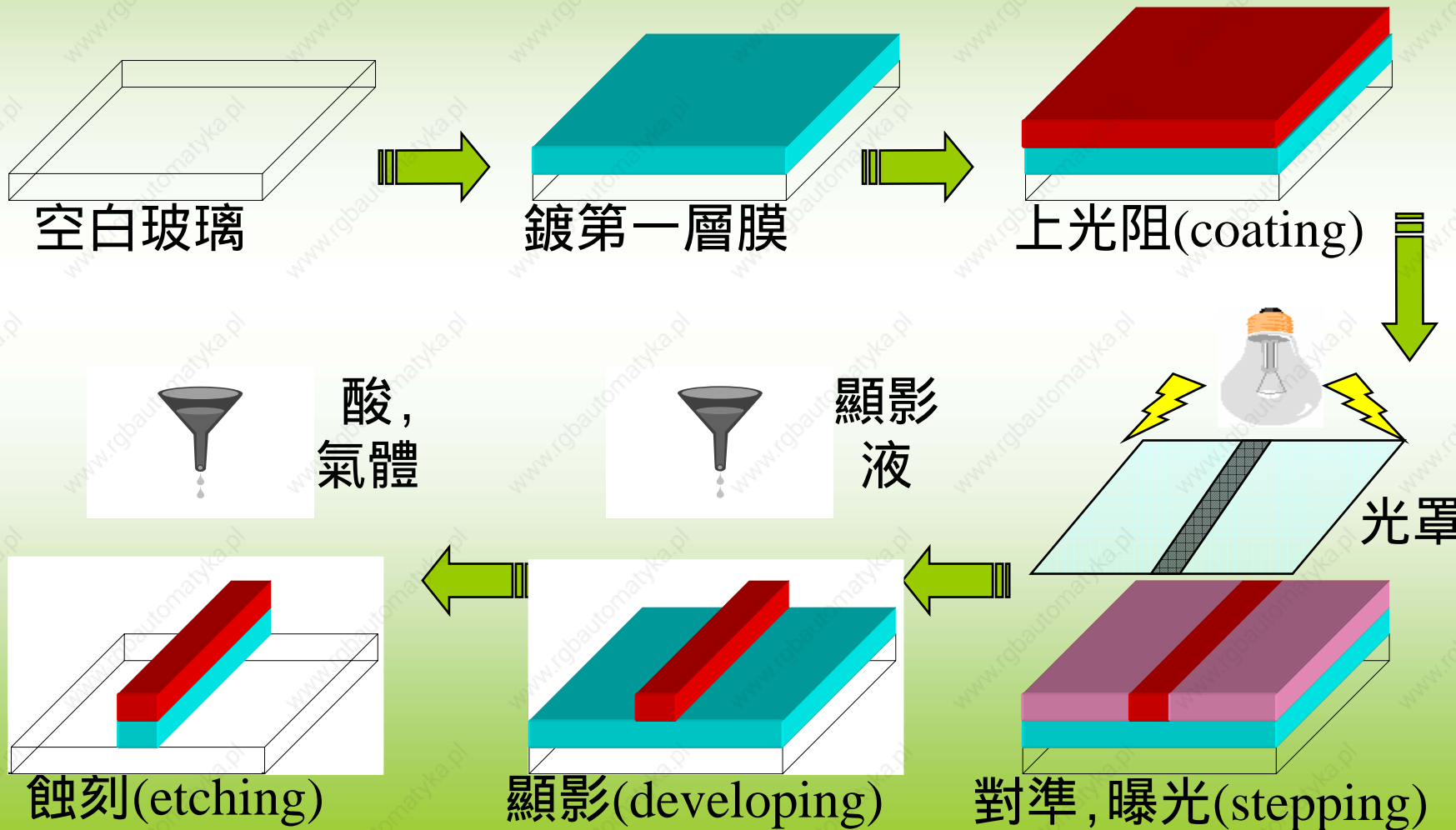
製造流程概述



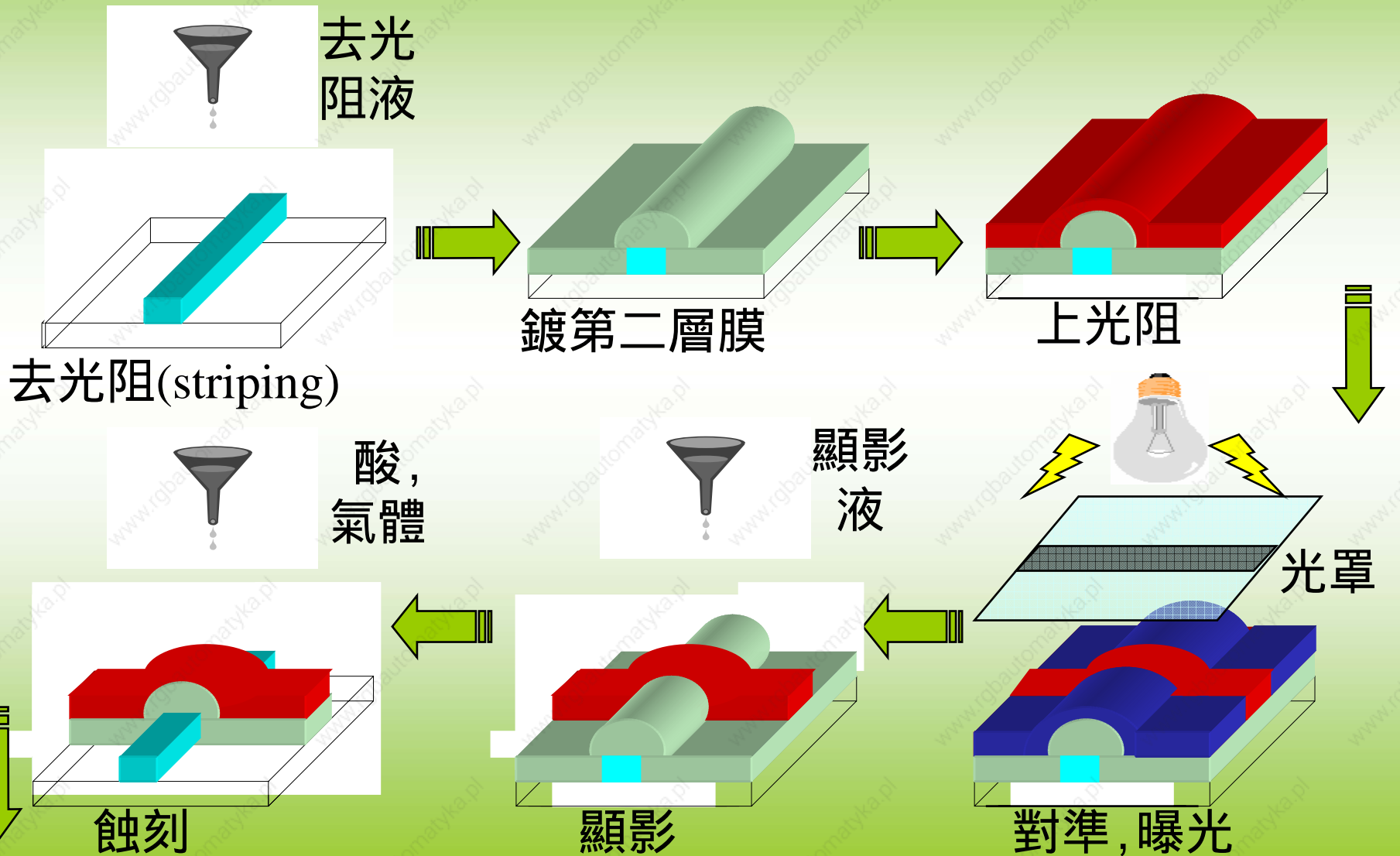
TFT的製造流程概述



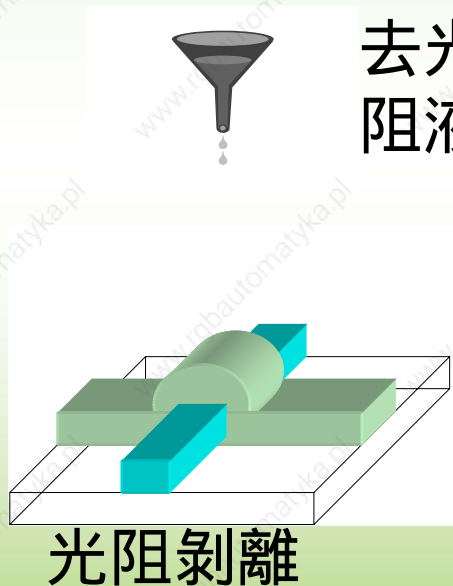
TFT的循環製程圖解 1/3



TFT的循環製程圖解 2/3



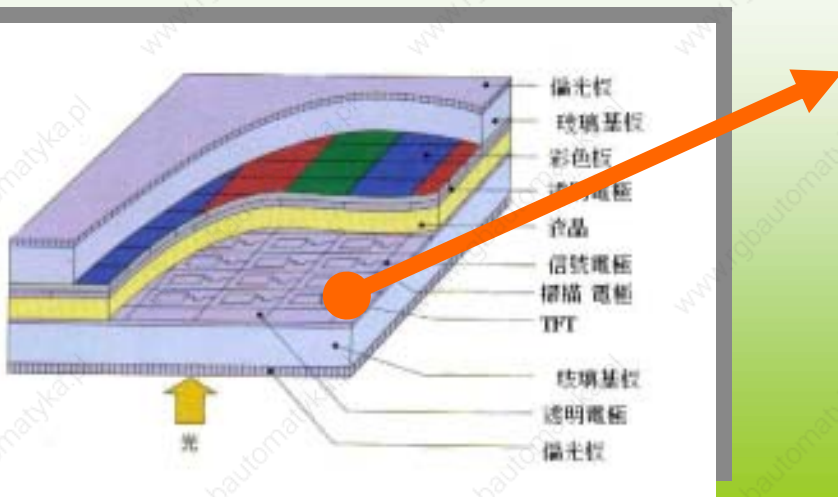
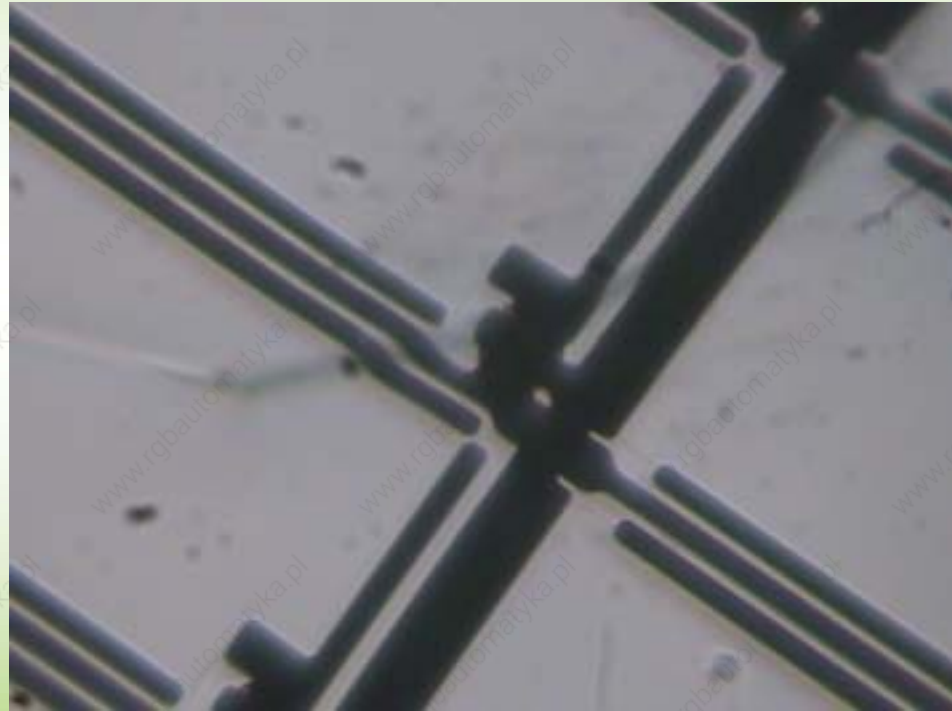
TFT的循環製程圖解 3/3



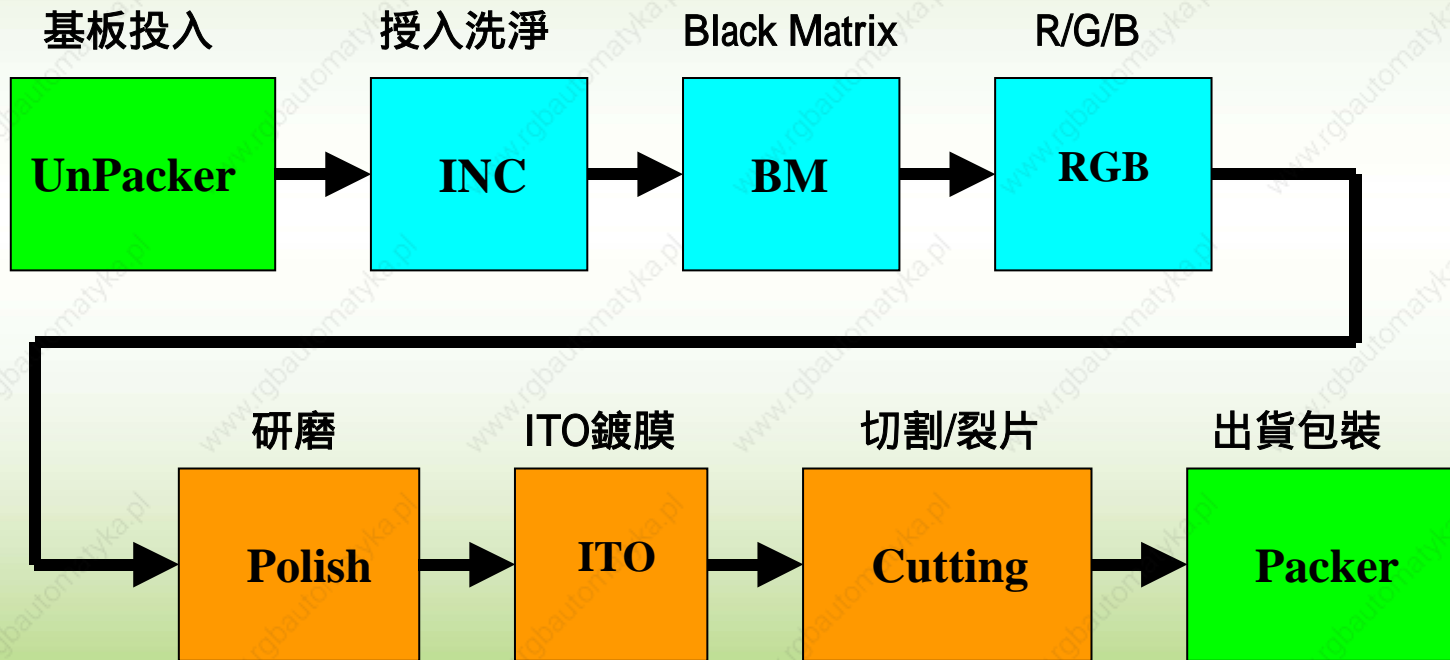
鍍第三層膜，
請依之前所
示範的方法
舉一反三，自
行模擬想像

TFT玻璃基板寫真

- TFT玻璃基板

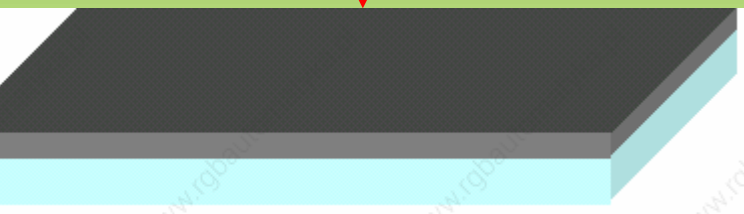


Color Filter 的製造流程 (一)



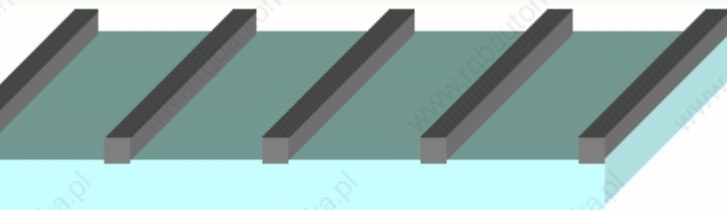
Color Filter的製造流程 (二)

Cr Glass Input



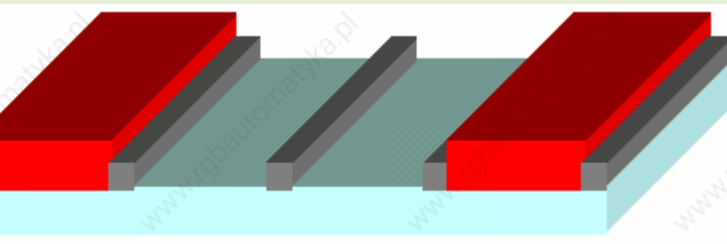
Black Matrix

Positive resist Coating, Dosing, Developing, Post-baking, Etching, Stripping.



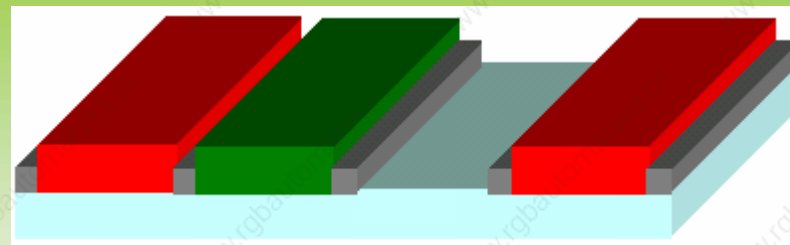
R sub-pixel

R Negative resist Coating, Dosing, Developing, Post-baking.



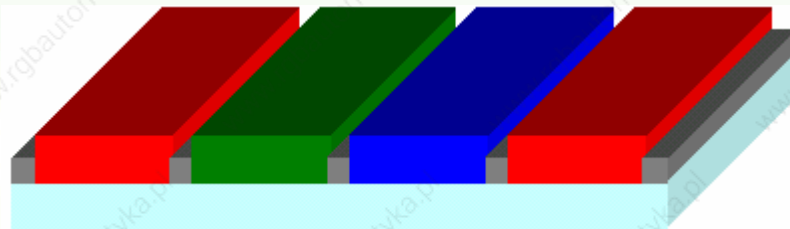
G sub-pixel

G Negative resist Coating, Dosing, Developing, Post-baking.

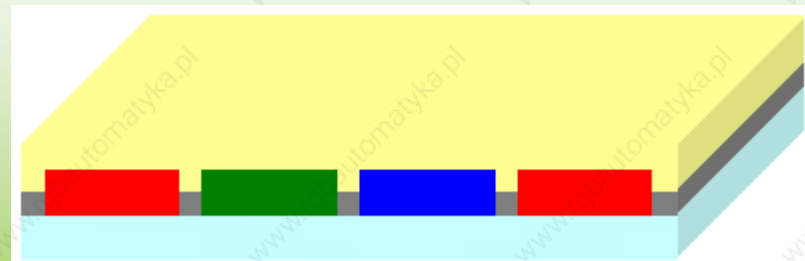


B sub-pixel

B Negative resist Coating, Dosing, Developing, Post-baking.



and then ITO

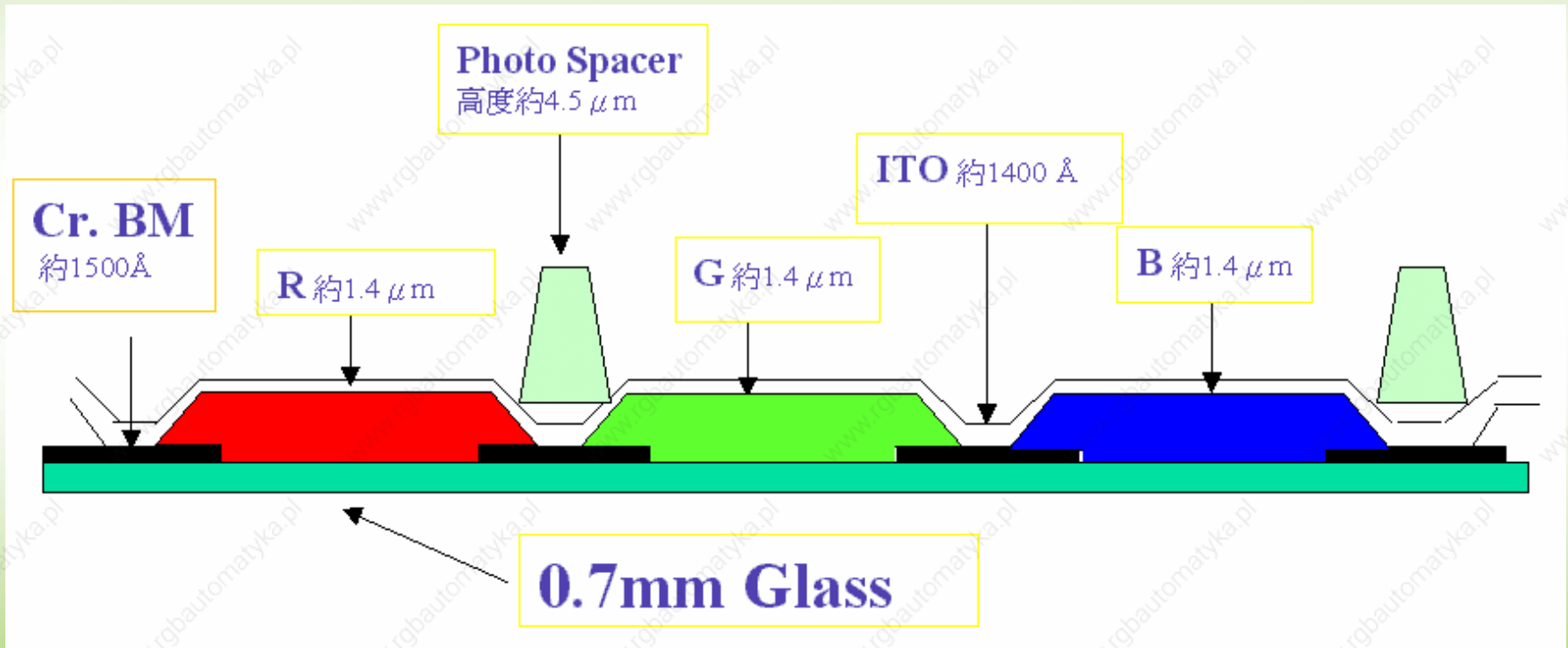


Cutting

Final Inspection

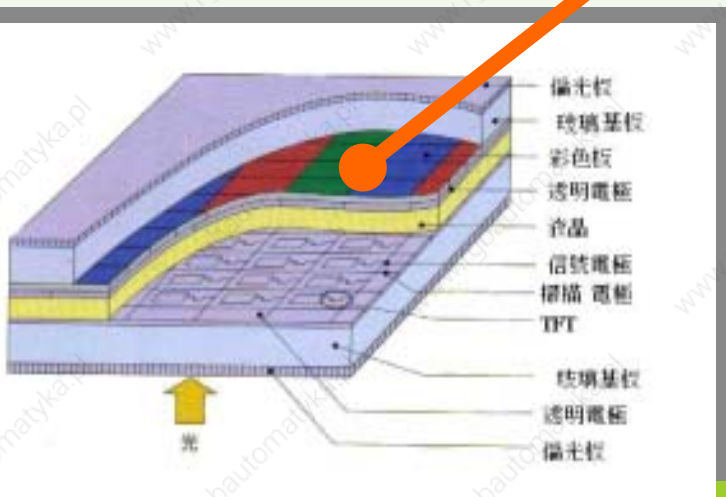
Color Filter Output

Color Filter的Profile

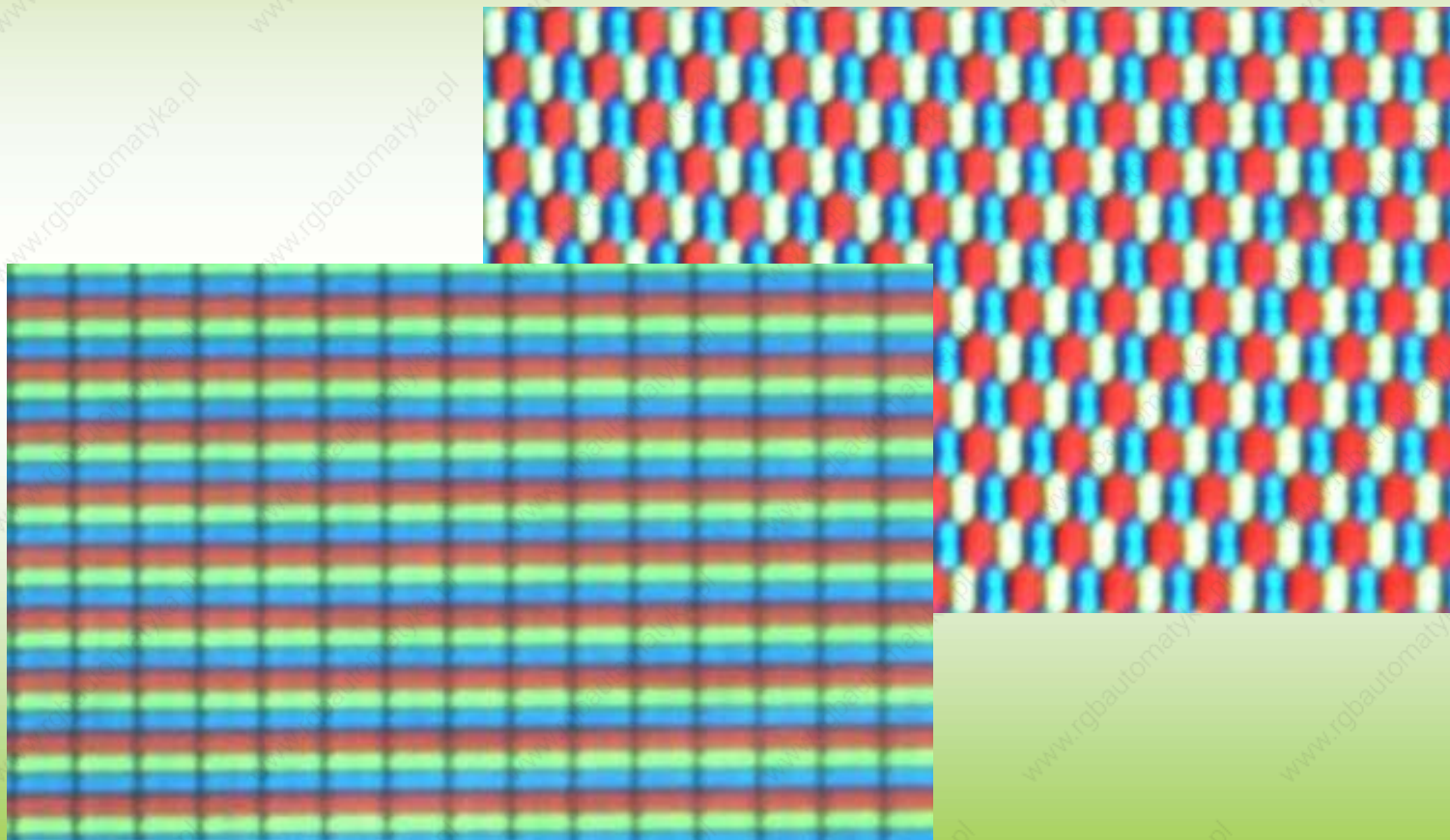


CF玻璃基板寫真

- 彩色濾光片



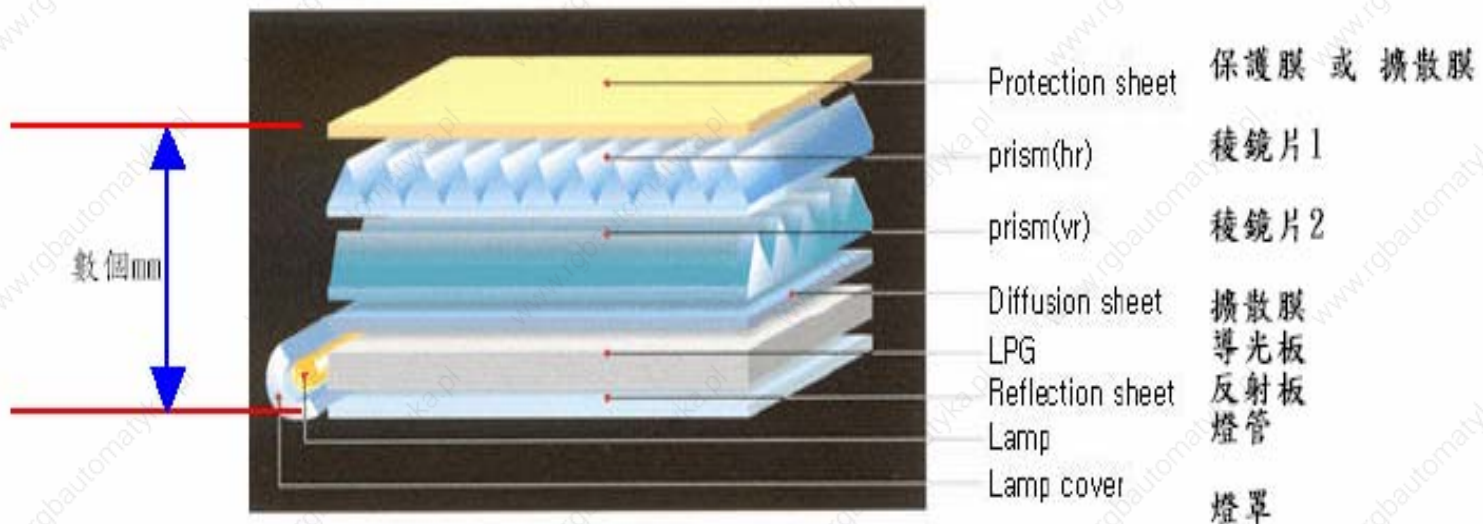
彩色濾光片RGB排列方式寫真



LCD結構解析

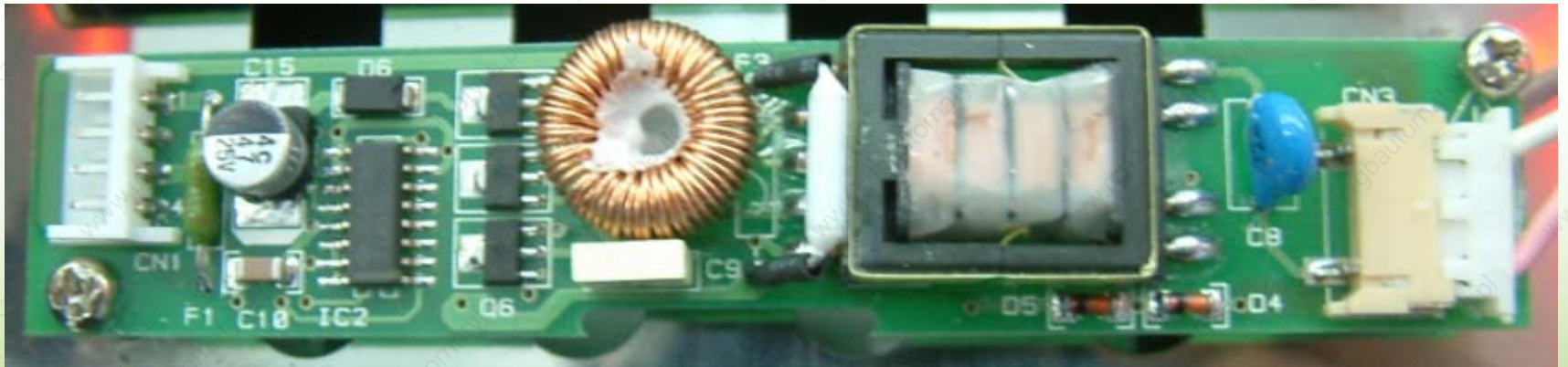
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LCD背光模組



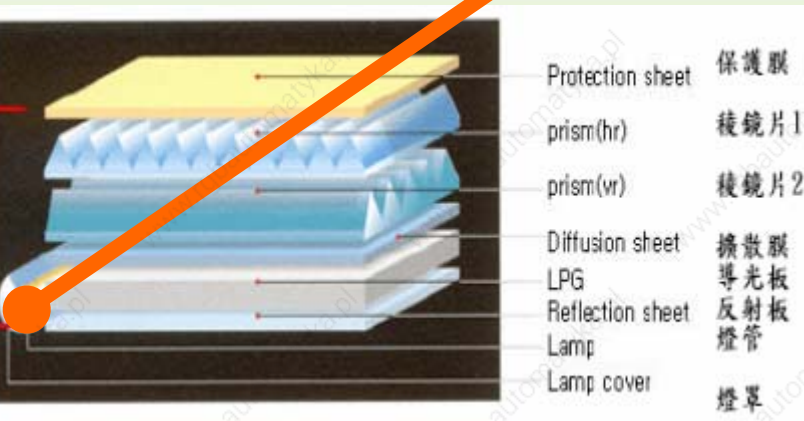
背光模組寫真

- CCFL驅動電路



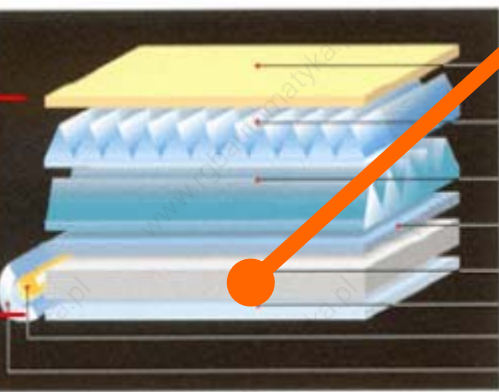
背光模組寫真

- 冷陰極管



背光模組寫真

- 導光板外觀



Protection sheet	保護膜
prism(hr)	稜鏡片1
prism(v)	稜鏡片2
Diffusion sheet	擴散膜
LPG	導光板
Reflection sheet	反射板
Lamp	燈管
Lamp cover	燈罩

背光模組寫真

- 導光板點矩陣

較密

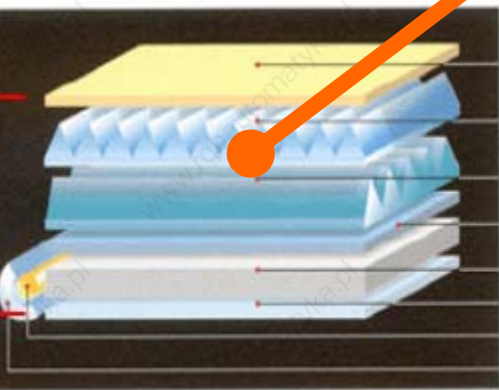


較疏

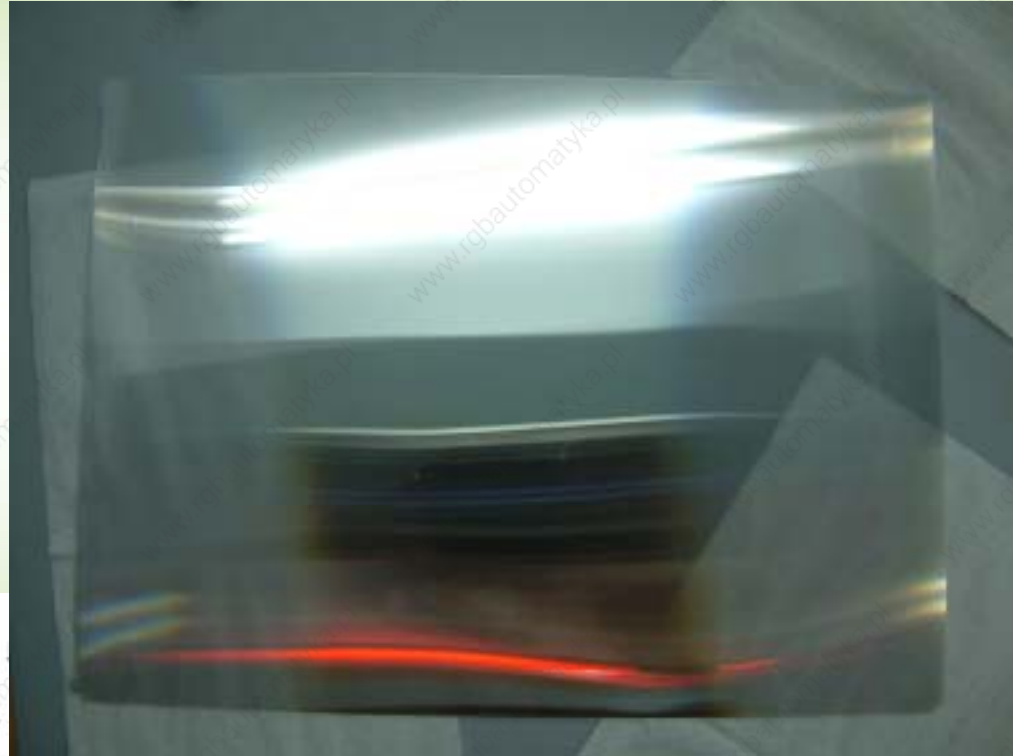


背光模組寫真

- 增亮膜



Protection sheet	保護膜
prism(hr)	稜鏡片1
prism(vr)	稜鏡片2
Diffusion sheet	擴散膜
LPG	導光板
Reflection sheet	反射板
Lamp	燈管
Lamp cover	燈罩



結論

- 拆解的困難度：
 - 液晶收集不易
 - TFT & CF的照片取得困難
- 感謝：
 - 老師指導拆解重點與場地設備提供
 - 同組夥伴,分工合作,順利完成報告

Q & A

