Thermal Management of Display Systems

光電顯示系統之熱管理

王安邦

Prof. Dr.-Ing An-Bang Wang

Institute of Applied Mechanics

National Taiwan University

TEL: 886-2-3366-5067

E-mail: abwang@spring.iam.ntu.edu.tw

Course Contents

Part I 基礎理論介紹

一、 光電顯示系統簡介 (9/20,27, 1.5 weeks)
二、 熱傳導 (9/27, 0.5 week)
三、 熱輻射 (10/4, 0.3 week)
四、 熱對流 (10/4, 0.7 week)

Part II元件與系統設計案例分析

五、案例一: 電漿電視與背投電視之設計與熱問題 (10/11, 1 week)
六、案例二: 熱管、被動散熱模組與設計(10/18,25, 2 weeks)
七、案例三: 風扇與主動散熱模組設計(11/1,8, 2 weeks)
八、案例四: LED設計與光源模組之熱管理 (11/15, 1 week)
九、案例五: 電子封裝之熱管理與設計(11/22,29, 2 weeks)
十、 案例六: 液晶電視之設計與熱管理 (12/6,13, 2 weeks)
十一、案例七: 筆記型電腦之設計與熱管理(12/20,27, 2 weeks)

Course Lecturers (I)

一~四、光電顯示系統簡介, 熱傳導, 熱輻射, 熱對流：

王安邦, 台大應用力學所教授

五、電漿電視與背投電視之設計與熱問題:

林清輝: 華映光電視訊部研發處處長,

莫啟能: 華映中央研究所多媒體光電處處長

六、案例二: 熱管、被動散熱模組與設計:

王啟川: 工研院能資所正研究員

七、案例三: 風扇與主動散熱模組設計:

陳世雄: 世鎰科技總經理

Course Lecturers (II)

八、案例四: LED設計與光源模組之熱管理:

李孝文: 日月光資深經理

九、案例五: 電子封裝之熱管理與設計:

黃新鉗: 工研院電子所前電子構裝組組長

十、 案例六: 液晶電視之設計與熱管理 :

黃崑峰:奇美電子IT產品開發一處處長

藍文錦:奇美電子IT產品開發一處副理

十一、案例七: 筆記型電腦之設計與熱管理:

林昇照: Intel經理

Grading & Lecture notes

◎ **Grading:**

Homework＋final report: 100%

◎ **Lecture notes:**

on web

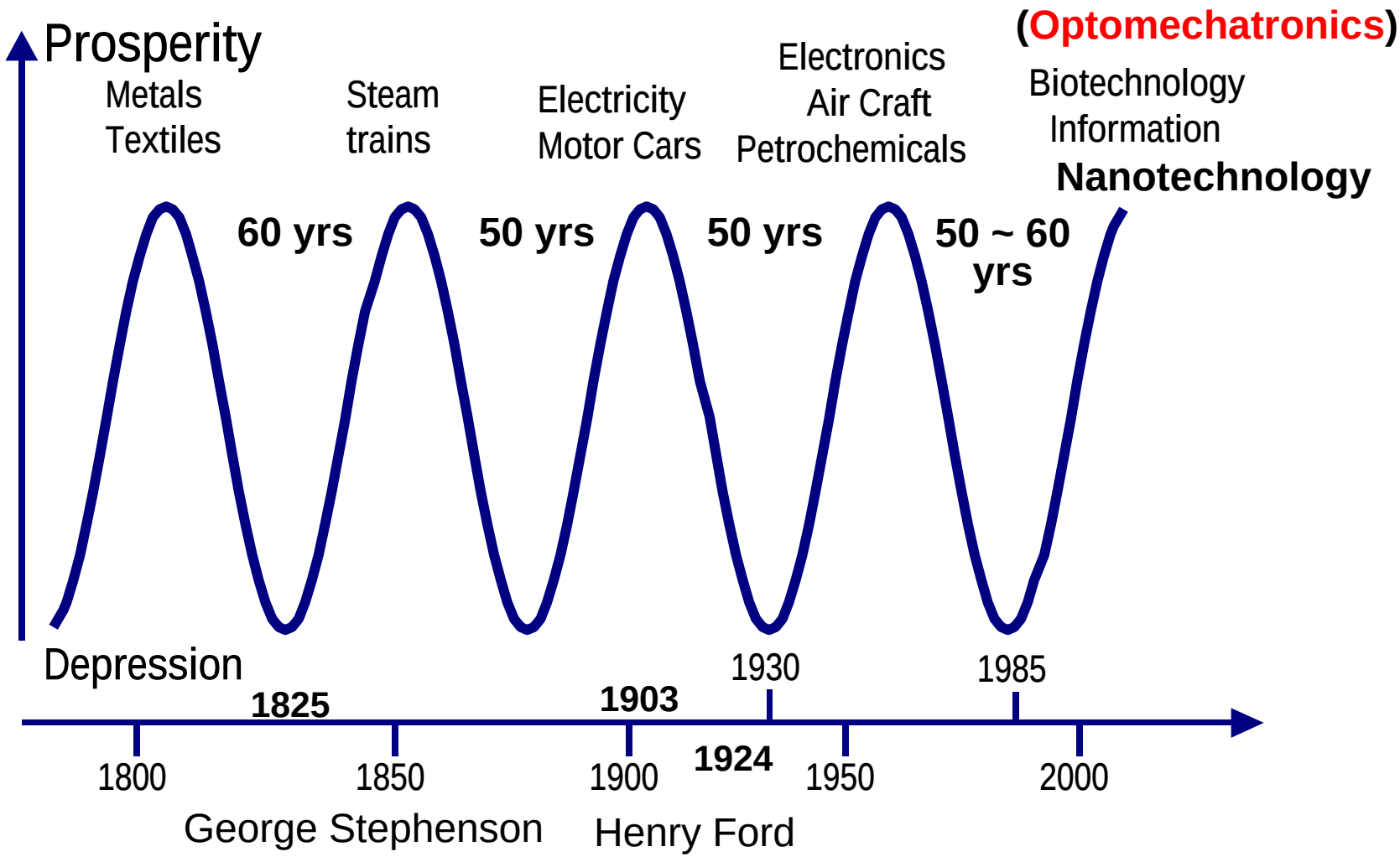
http://bernoulli.iam.ntu.edu.tw/tw/index.htm

光電顯示系統簡介

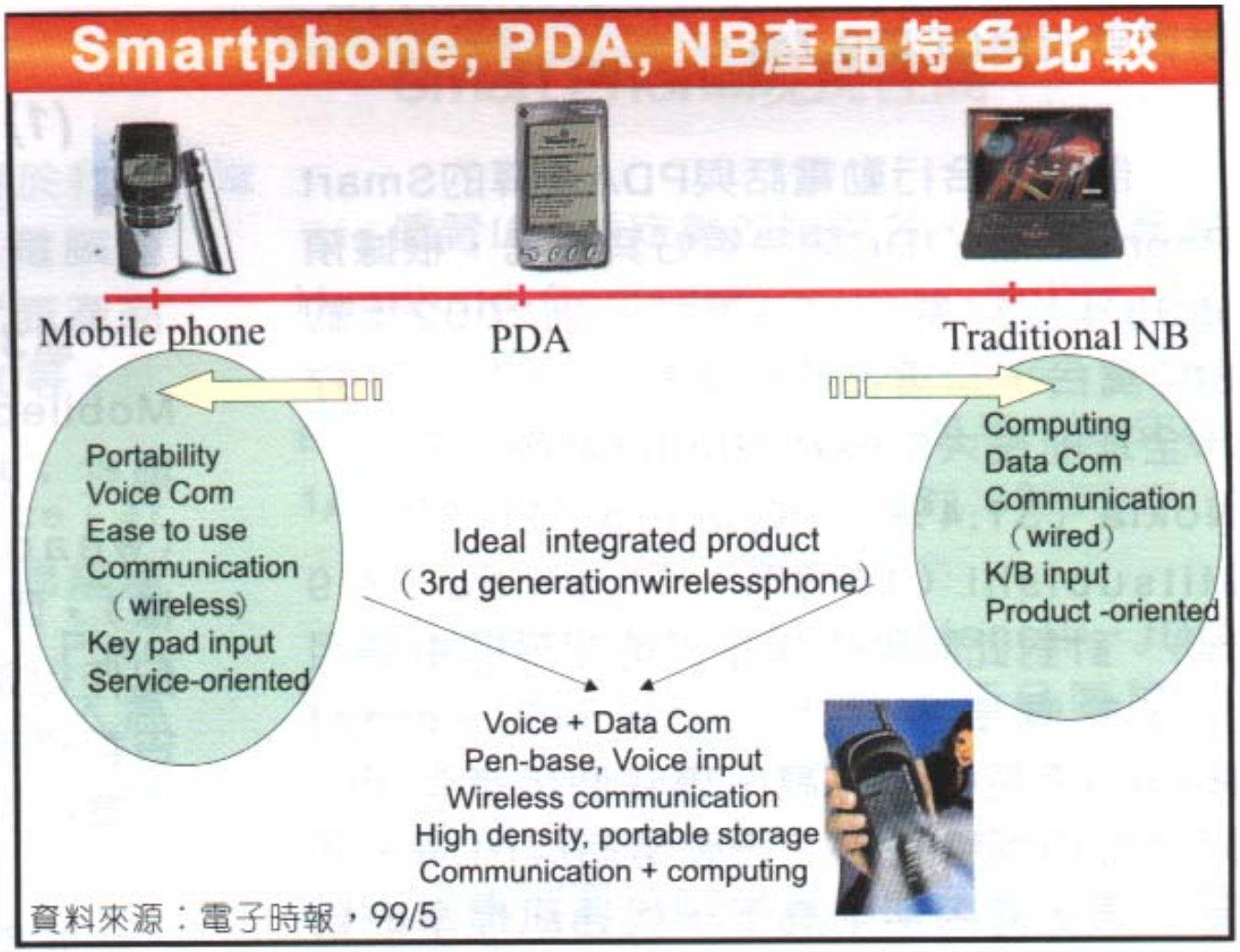
Contents

- Introduction to Display technology
- Introduction to LCD
- LED, OLED/PLED
- Micro display
- Large size Display
  (LED, Projection, PDP, LCD)

Trend of the world



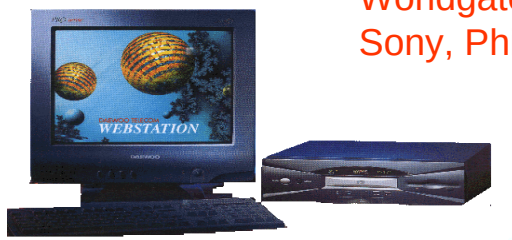
3C products


Smartphone, PDA, NB產品特色比較
Mobile phone
PDA
Traditional NB
Portability
Voice Com
Ease to use
Communication
(wireless)
Key pad input
Service-oriented
Ideal integrated product
(3rd generationwirelessphone)
Computing
Data Com
Communication
(wired)
K/B input
Product -oriented
Voice + Data Com
Pen-base, Voice input
Wireless communication
High density, portable storage
Communication + computing
資料來源：電子時報，99/5

IA-products

Net TVs

Worldgate / Worldgate
Sony, Philips / WebTV



E-mail terminals

Air Communication / Smart Phone
Nokia/ 9000Communicator
Motorola / MAPS

Gaming console devices

Sega / Dreamcast
Sony / PlayStation 2
Ninterdo / Dolphin

Internet

Smart handheld devices

Compaq / Aero series
3Com,Palm / Palm VII
Hewlett-Packard / Jornada series

Web terminal

Wyes, Hewlett-Packard,
NCD/Tektronix, Sun,
Boundless, Neoware

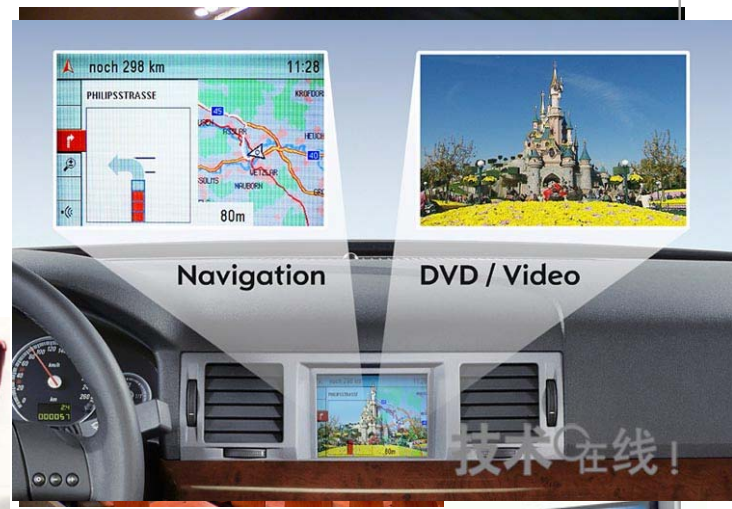
Screen Phones

InfoGear / iPhone
Alcatel / WebTouch
Nortel / Power Touch

影像顯示科技

- 視覺為五覺之首，是接受資訊與知識之大門

影像顯示科技
- 內涵 (數位內容)
- 外表
  - 軟顯示器
  - 硬顯示器

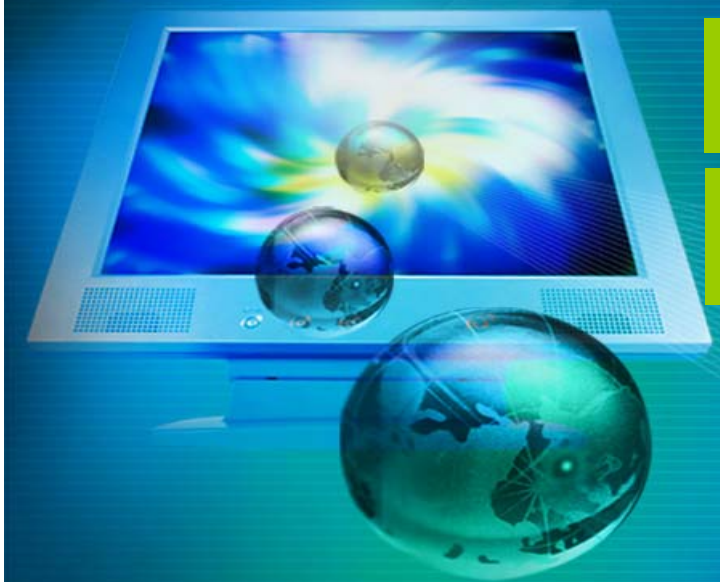


Why Display?

- Why display?
  - Man-machine-interface
  - Display is a device used to exchange information between man and machine.
  - The contents of information could be numbers, text, and graphics.
- Requirements for display are: rightness, contrast, response speed, memory, … etc.

光電顯示系統教學展示中心

影像顯示及光機電科技
教學展示中心



LCD 概述

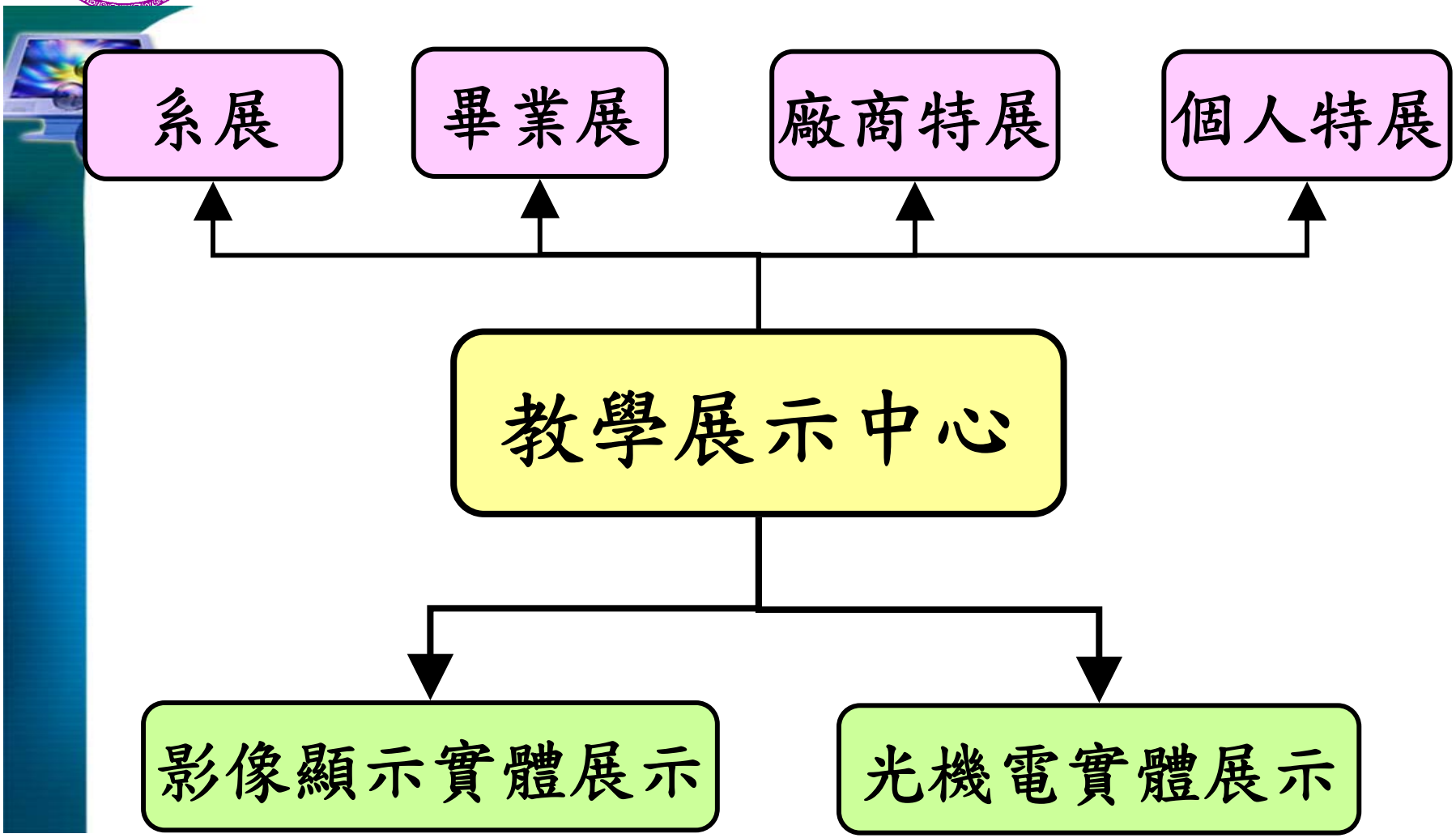
PDP 各部件概述

OLED 概述

計畫主持人： 王安邦 教授

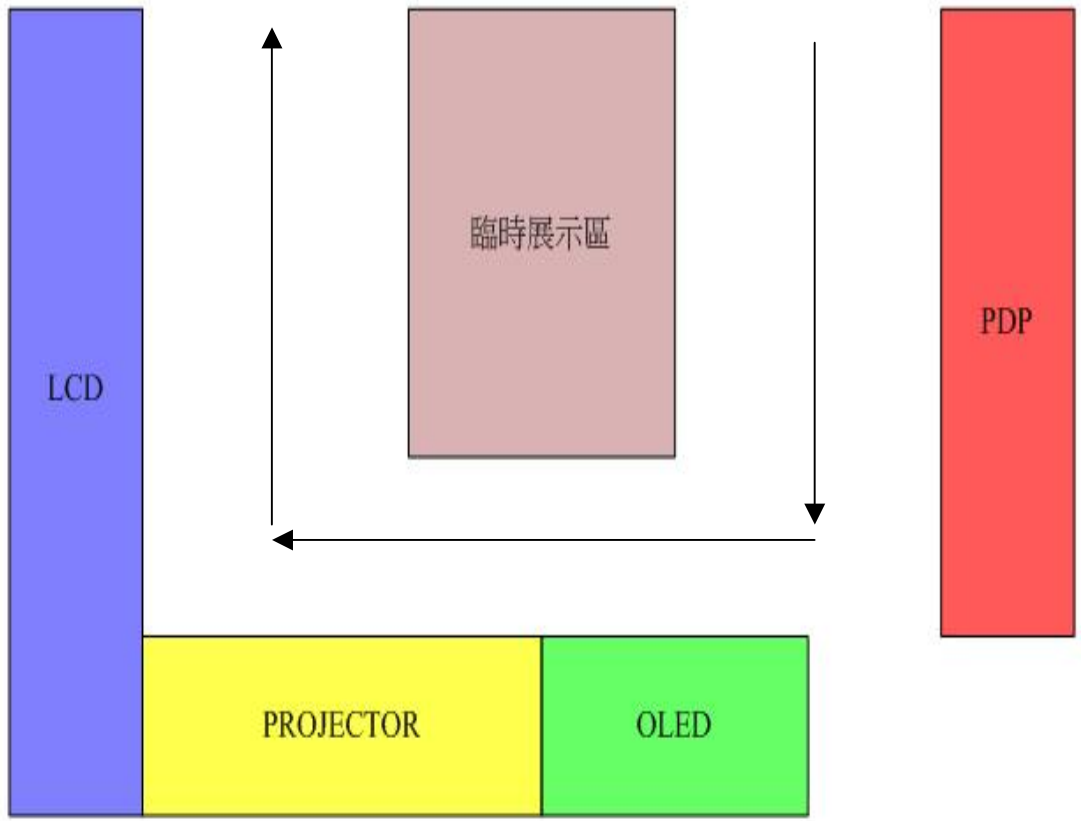
共同主持人： 林輝政 教授
郭茂坤 教授
黃榮山 教授

光電顯示系統教學展示中心

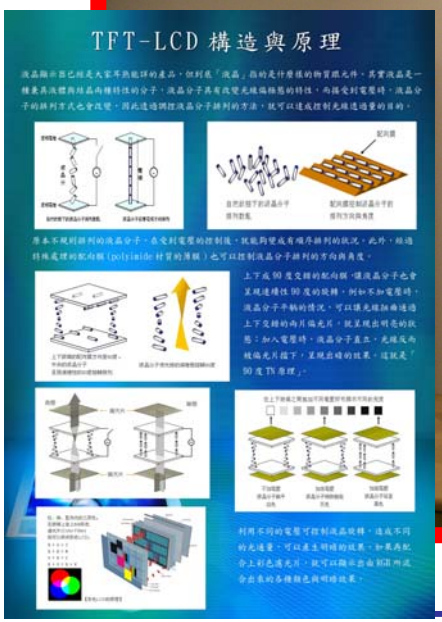


光電顯示系統教學展示中心

展示區參觀動線規劃



光電顯示系統教學展示中心



一、計畫目標

本計畫旨在綜整光機電與影像顯示科技領域的相關知識，統籌與規劃相關的資源，建構豐富的科技教育學習環境。規劃實體的展示與遠距教學實驗兩項重大特色，構築成本計劃之教學展示中心。讓民眾可以直接面對面的接觸相關訊息，從而達到光機電科技領域知識的推廣與管理。

二、教學展示中心

台灣大學設立有關影像顯示及光機電科技的「教學展示中心」，在此中心下設有「實體展示」與「遠距教學實驗」為其兩大教學主軸。藉由精緻化低成本教材製作、廠商合作提供實體展示、遠距教學實驗教材製作三部份來提供教學展示中心內容，並經由這個教學展示中心，提供科普教學（中小學教師）、推廣教育（社會大眾）、專業學習成長（專業人士）、學生教學學習（大學、研究所同學）等影像顯示及光機電科技知識，發揮培育優秀專業人才功能。

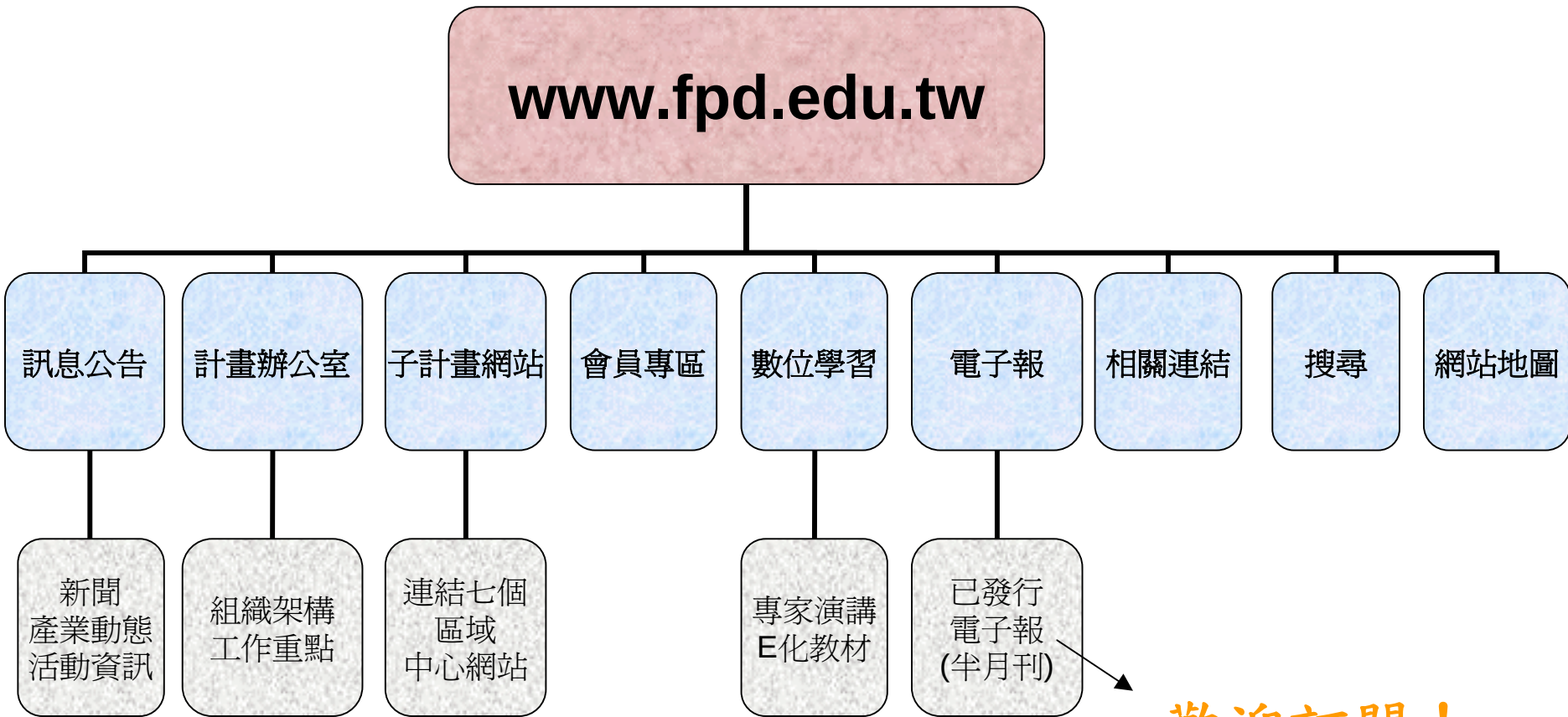
台灣大學應用力學研究所
Institute of Applied Mechanics,
National Taiwan University

(By An-Bang Wang)

光電顯示系統之熱管理

光電顯示系統簡介

影像顯示科技電子知識平台



歡迎訂閱！

影像顯示知識平台


影像顯示科技人才培育網
Image Display Technology
友達參訪活動專區
AUO AWARD
專題競賽專區
COMPETITION INFORMATION
訊息公告
NEWS
計畫辦公室
THE PROJECT
子計畫網站
SUBPROJECT SITE
會員專區
MEMBERS
數位學習
E-LEARNING
電子報
NEWSLETTER
相關連結
LINKS
搜尋
SEARCH
網站地圖
SITEMAP
新聞
北東區將於7/14舉辦工作觀摩會 (2005/06/20)
敬邀參加「推動技專校院影像顯示科技人才培育與實務特色」研討會 (2005/06/20)
雲嘉區93年度跨校實作實驗暑期課程表出爐 (2005/06/15)
友達獎專題競賽參訪活動資料 (2005/06/15)
影像顯示科技人才培育計畫94年度種子師資舉辦細節 (2005/06/15)
more...
產業動態
液晶周期考驗產業應變 中國造時代是否來臨 -- ICT信息中心
三星LG17英寸LCD顯示器降價到300美元以下 -- ICT信息中心
液晶周期考驗產業應變 中國造時代是否來臨 -- ICT信息中心
一季度背投彩電市場萎縮 液晶引領高端電視 -- ICT信息中心
彩電聯盟力避重蹈覆轍 跨國公司冷眼旁觀（2） -- ICT信息中心
課程資訊
中區影像顯示科技種子師資班---熱情招生中！ (2005/06/29)
雲嘉區93年度跨校實作實驗暑期課程表出爐 (2005/06/15)

影像顯示知識電子報

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光電顯示系統之熱管理

光電顯示系統簡介

影像顯示科技專題實作競賽

- 專題競賽為人才培育成果之具體表現
- 主旨：鼓勵培養具實務能力之人才
- 特別獎：結合科技與人文藝術，促進人文藝術相關系所院校參與---人文藝術獎
- 產學合作：促進產業參與實作過程互動與評比，提昇參賽作品應用價值

  鼓勵業界參與、聘請產業界人士參與評比並設立業界獎項

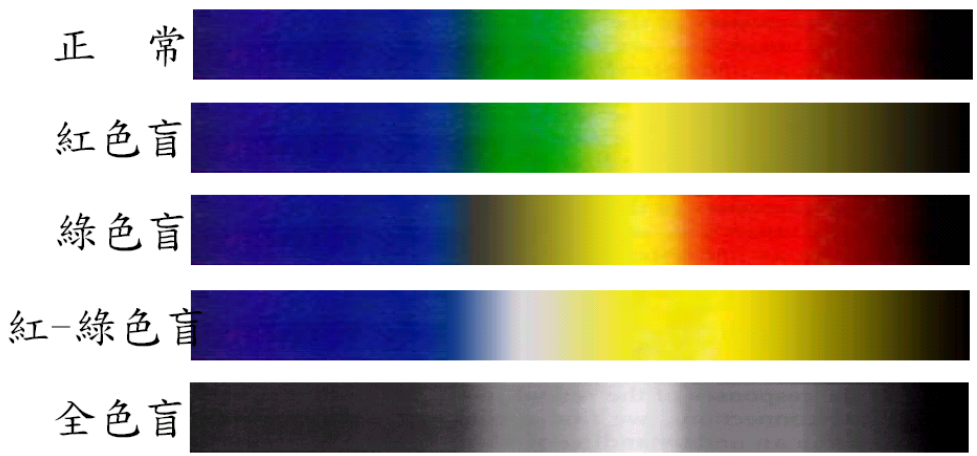
第一屆 影像顯示實作友達獎
兩個百萬獎金大挑戰!!!

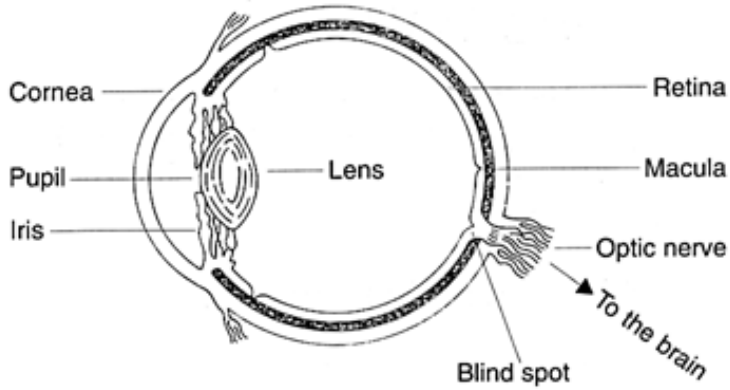
Image

- "*Seeing is believing*."
- Elements of a Image:

  - **Light source：**
    Sun-light, spot light, laser, CCFL, LED, EL …
  - **Objects**
    text, picture,
  - **Recording device**
    Eye, Camera,Video Cam., Cinematography, CCD, DV

Vision

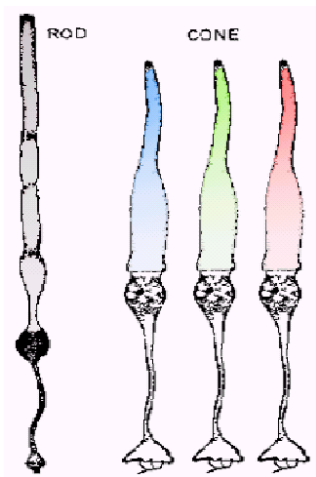


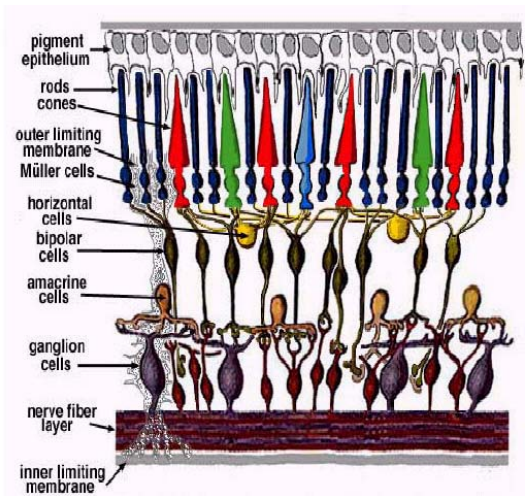


桿狀細胞：10^{-6}~10　cd/m^2

錐狀細胞：10^{-3}~10^{8}　cd/m^2

(Color, shape)





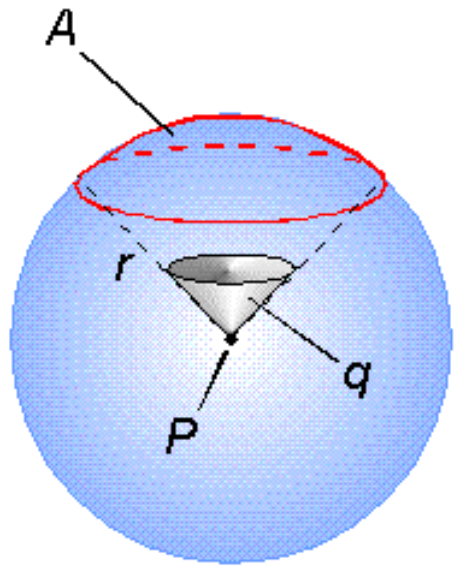
(From 詹文鑫)

Unit of illumination

❑ **Units of illumination (one of System International units, SI) :**

Unit		Symbol	Quantity measured
Dimensioned	1. Meter	m	Length
	2. Kilogram	kg	Mass
	3. Second	s	Time
	4. Ampere	A	Electric current
	5. Kelvin	K	Temperature
	6. Mole	mol	Amount of substance
	7. Candela	**cd**	**Luminous intensity**
Dimensionless	8. Radian	rad	Plane angle
	9. Steradian	**sr**	**Solid angle**

If $A = r^2$, then $q = 1$ sr



1 Candela (cd 燭光): a power level of 1/683 watt (1.46×10^{-3} W) per steradian at a frequency of 5.40×10^{14}Hz.

1 nit = cd/m^2

1 Lumen (lm 流明) = 1 cd emitted in angle of 1 sr

台灣LCD產業之發展

1. 扭轉向列 (Twisted Nematic, TN)型LCD
   1976年敬業電子與美商修斯飛機公司
2. 超扭轉向列 (Super Twisted Nematic,STN)型LCD
   1985年碧悠電子與美商歐利寶
3. 薄膜電晶體 (Thin Film Transistor,TFT) 型LCD
   1988年工研院電子所,1992年聯友光電,1993年元太科技
4. 大尺寸(10”以上)TFT-LCD
   1997年起華映(+三菱ADI)、友達(+松下,IBM) 、奇美(+富士通,IBM) 、瀚宇彩晶(+東芝) 、廣輝(+Sharp)

ICs vs. Display Industry (I)

- ICs
  - Doubling the number of transistors on a wafer every 18 months through advancing process equipment to process smaller design rules.
  - Design rules & process could be standardized or simulated
  - Design house contribution
  - Going smaller and smaller
- TFT LCDs
  - Grow the substrate size every two years to double the number of panels per substrate by growing process equipment.
  - LCD process is still an “art”
  - Design house? It happened but not yet proven
  - Going larger and larger

(From C.E Wang)

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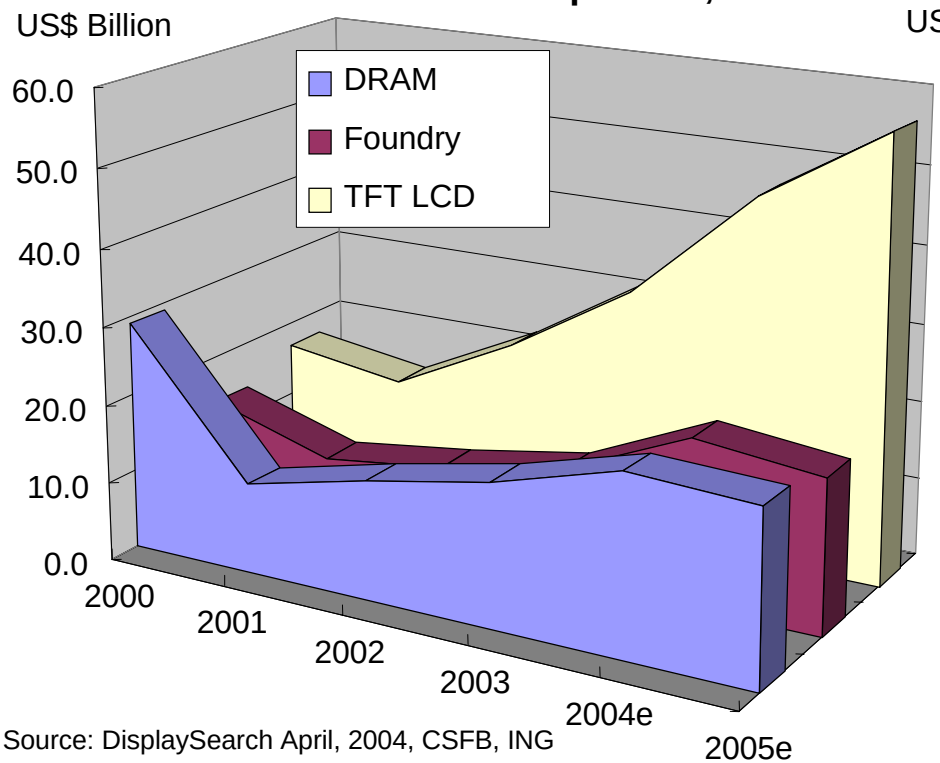
(From C.E Wang)

ICs vs. Display Industry (II)

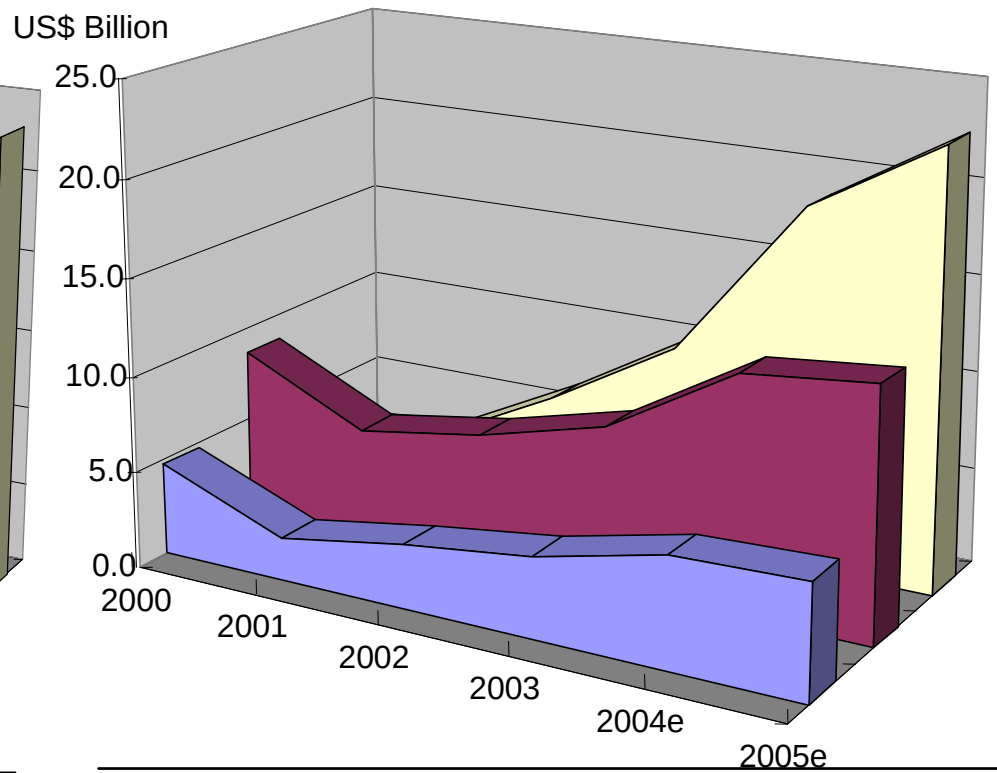
Global Revenue Comparison, 00'-05'



Source: DisplaySearch April, 2004, CSFB, ING

Rev. ($B)	2000	2001	2002	2003	04e	05e
DRAM	29.2	11.4	15.1	18.2	22.8	22.0
Foundry	14.0	9.2	11.3	14.2	21.3	19.6
TFT LCD	*16.8*	*14.6*	*22.3*	*32.1*	*47.7*	*54.9*

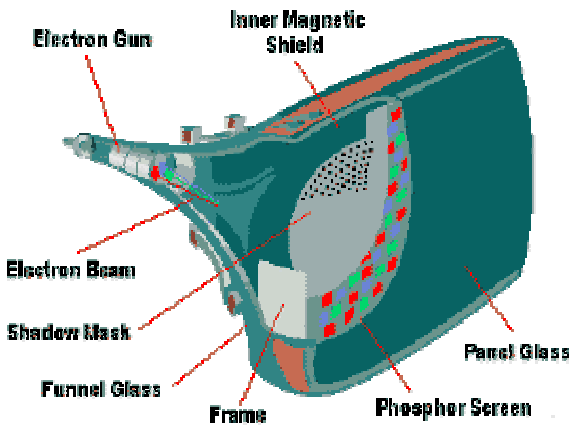
Taiwan Revenue Comparison, 00'-05'



Rev. ($B)	2000	2001	2002	2003	04e	05e
TWN DRAM	4.8	2.2	3.3	4.2	5.7	5.9
TWN Foundry	8.7	5.6	6.6	8.3	12.2	12.9
TWN TFT	*2.4*	*3.1*	*6.4*	*10.3*	*18.7*	*22.7*

CRT & FPD

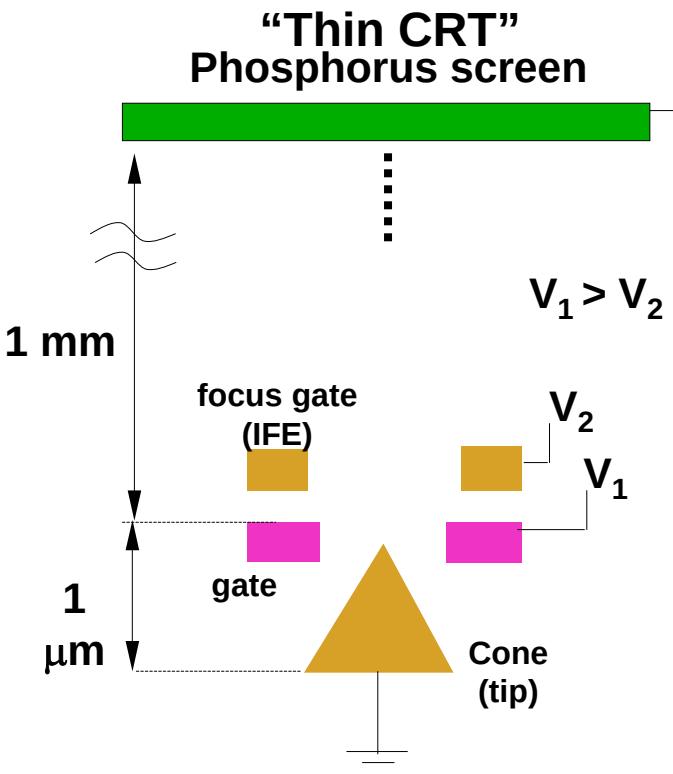
CRT: Cathode Ray Tube
FPD: Flat Panel Display

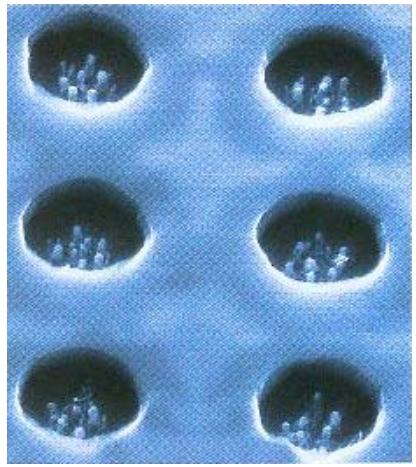


- Display
  - Direct View
    - CRT
    - FPD
      - PDP
      - LCD
      - LED
      - OLED/ PLED
      - Micro-display
      - FED
  - Projection

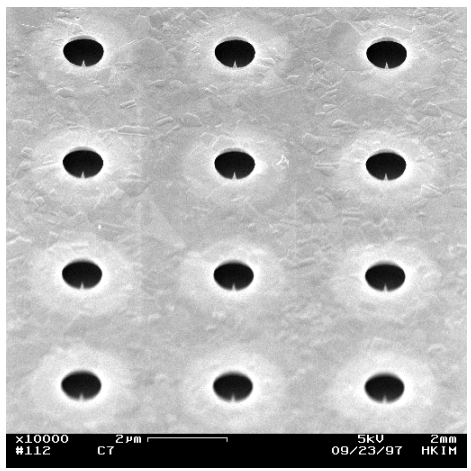
FED (Field-Emission Device/Display)

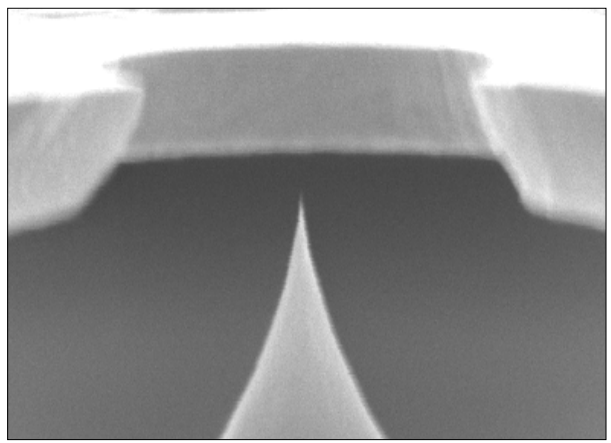
- **Silicon emitters fabricated by oxidation sharpening and CMP techniques**





Carbon nanotube FED



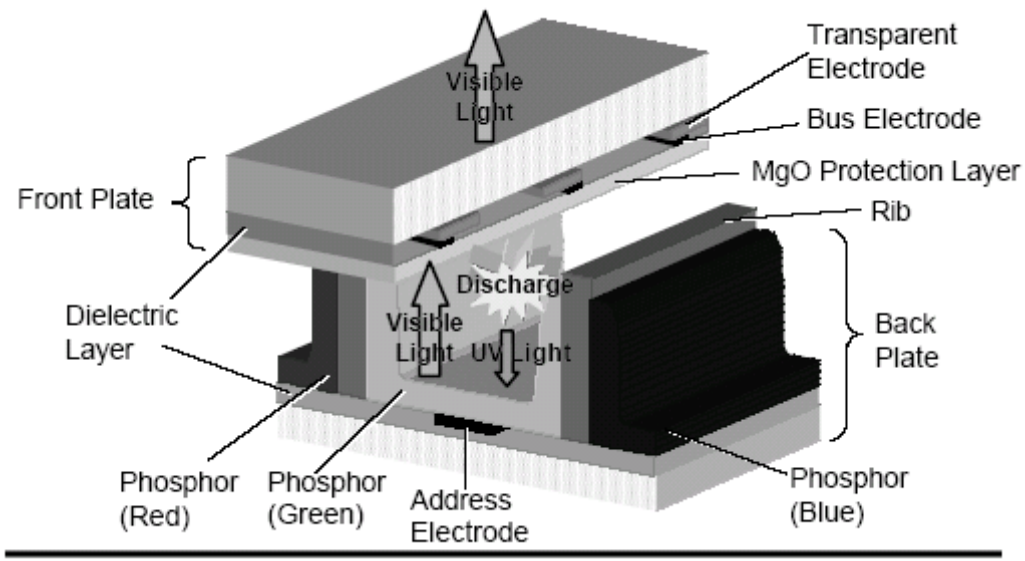


Problem: mass-production process & acceptable lifetime

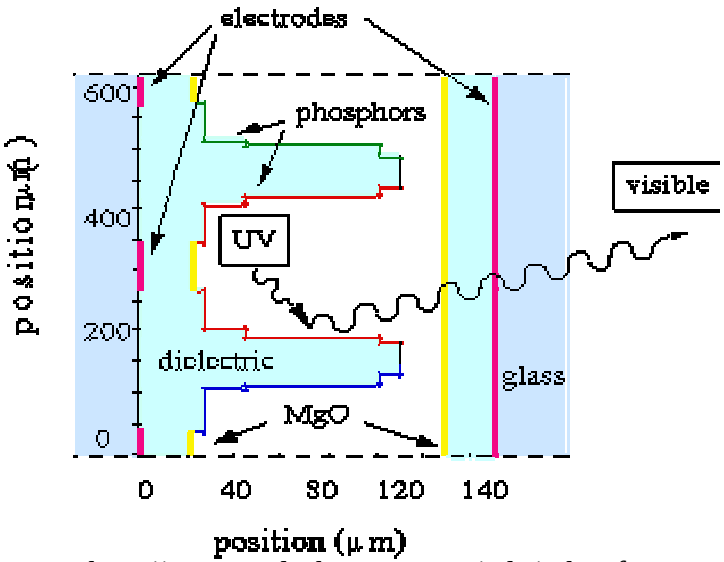
Source: Dr. H. Kim

PDP

- PDP: Plasma (電漿/等離子體) Display Panel
- PDP乃指"利用放電發光的顯示器". 在真空玻璃管中注入惰性氣體(Ne-Xe/He-Xe)，加電壓放電產生UV光,照射玻璃管內的螢光塗料發光 .



(From: 陳光郎)

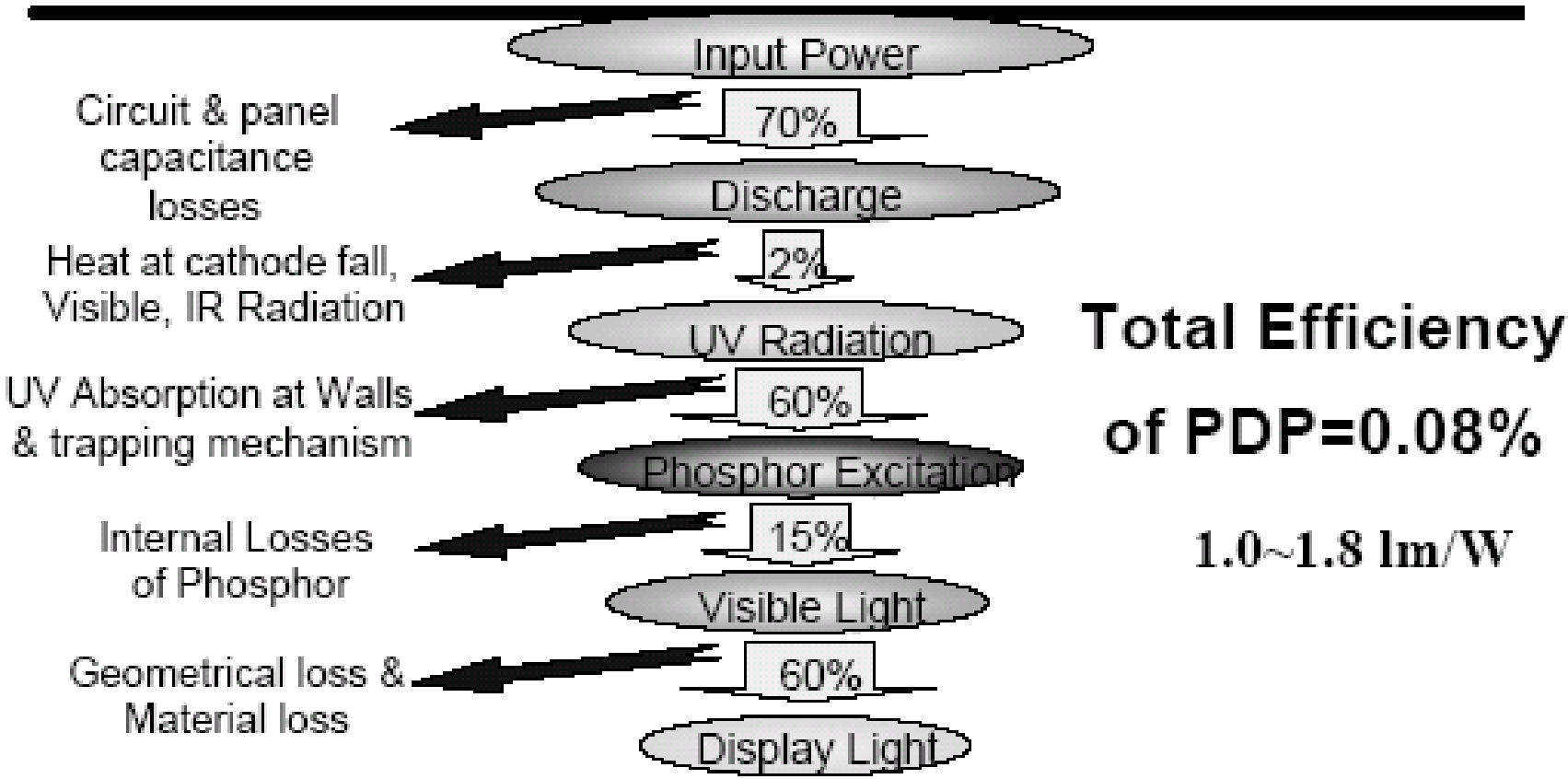


http://www.siglo-kinema.com/pdp/sch.gif

PDP

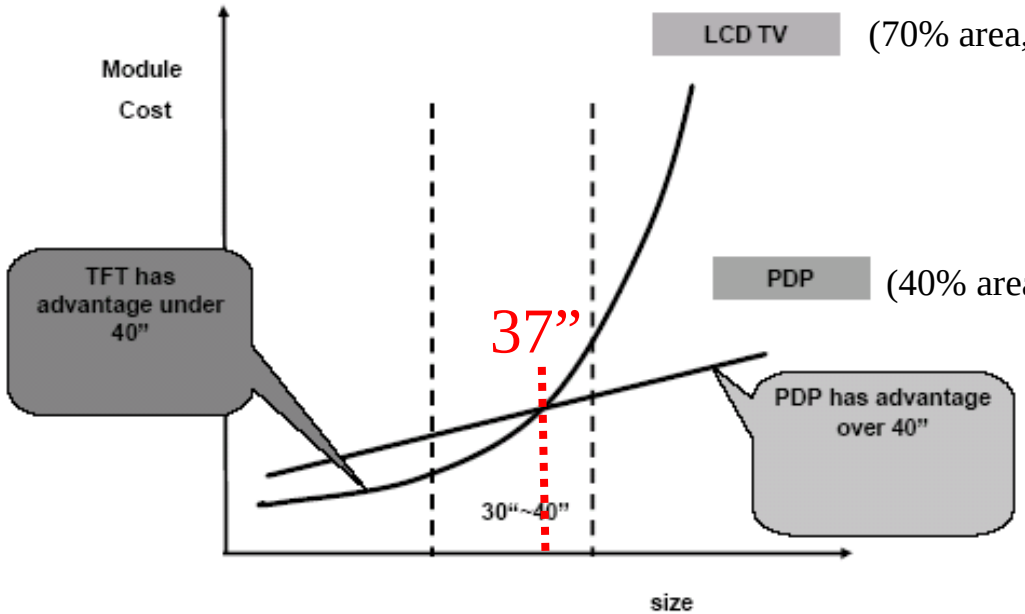
- 特色:
  - 平面、大畫面、相對薄(3~4”)
  - 廣視角(上下左右~160º) 、相對輕(~1/4 of CRT) 、影像不受地磁影響
- 數位訊號
- 友達、華映、臺塑、聲寶
- 63” available, max. 76”LG @ 2003/10
- Disadvantages:
  - Static burn-in problem, Power consumption, Cost, EM & IR radiation,

Total efficiency of PDP



(From: 陳光郎)

Cost comparison of PDP & LCD-TV



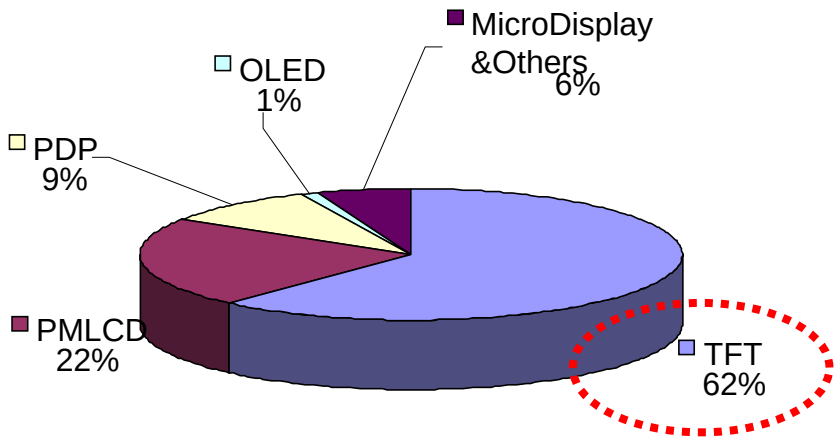
Generation	Substrate Size (mmxmm)	Capacity-Mother Glass (K pcs/M)	Capacity-42"panel (K panel/M)	Total Investment (Billion NT)	Investment per K panel/M (Billion NT)
LCD(G6)	1500 x 1850	90	270	66.3	0.25
PDP(G2)	968 x 1746	25	75	13.6	0.18
PDP(G3)	1936 x 1746	20	120	18.0	0.15

42"模組投資金額PDP：TFT = PDP(G2) 73.85%
PDP(G3) 61.09%

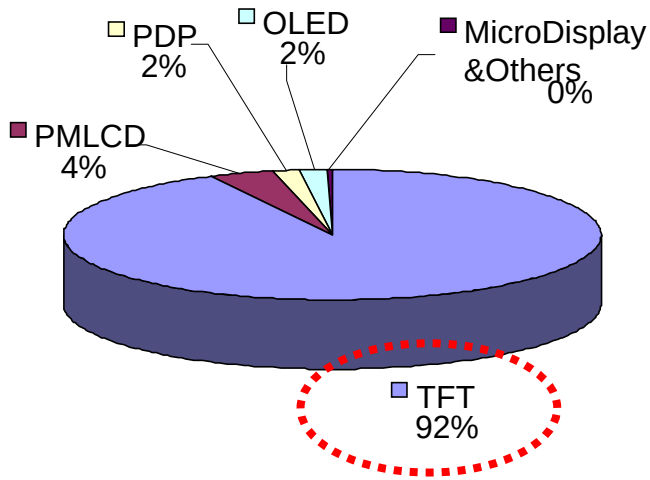
(From: 陳光郎)

TFT-LCD vs. FPD

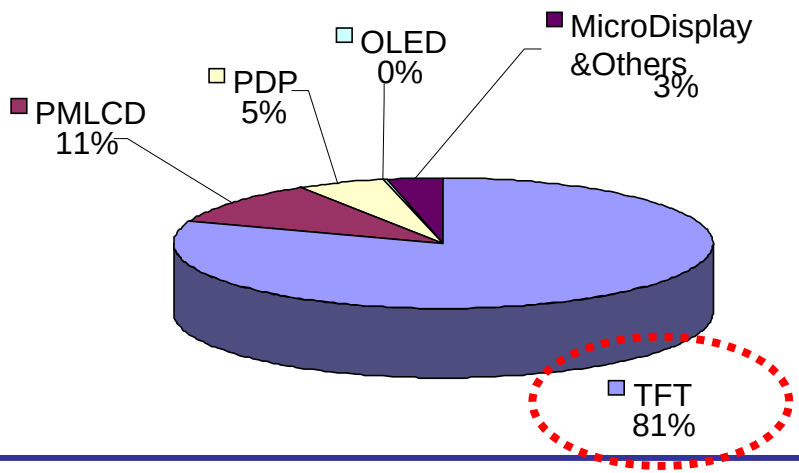
2003 FPD Revenue by Technology - Japan



2003 FPD Revenue by Technology - Taiwan



2003 FPD Revenue by Technology - Korea

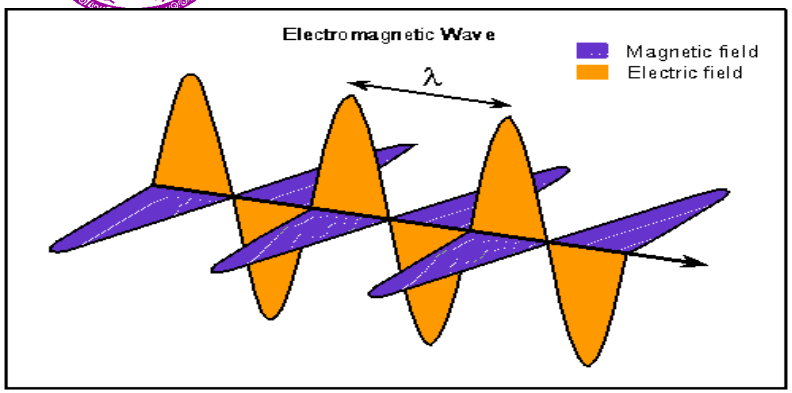


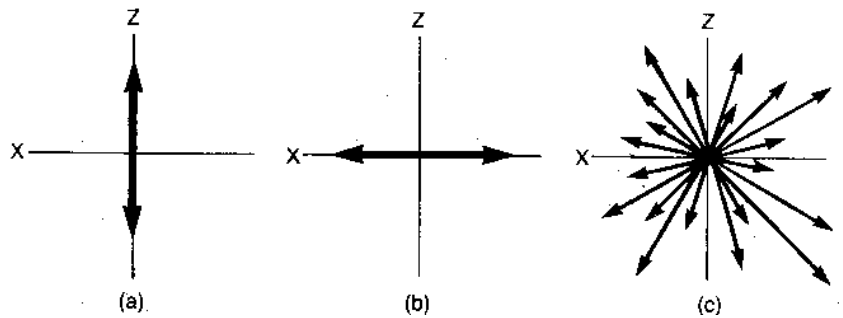
(From: DisplaySearch)

Basic Characteristics of Display

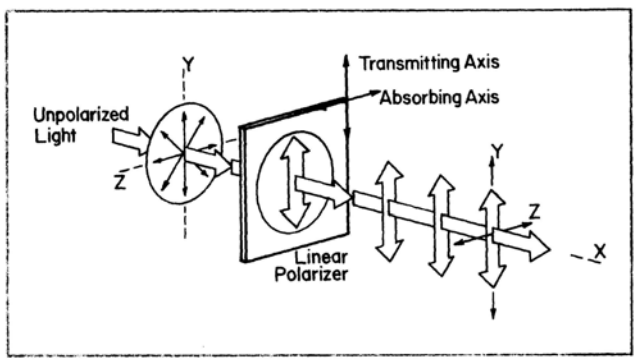
- ***Low cost***
- Lightweight
- Thin
- Wide view angle
- High contrast ratio and brightness
- Low power consumption and voltage
- Fast response time for wide temperature range
- Availability of full color
- Robust

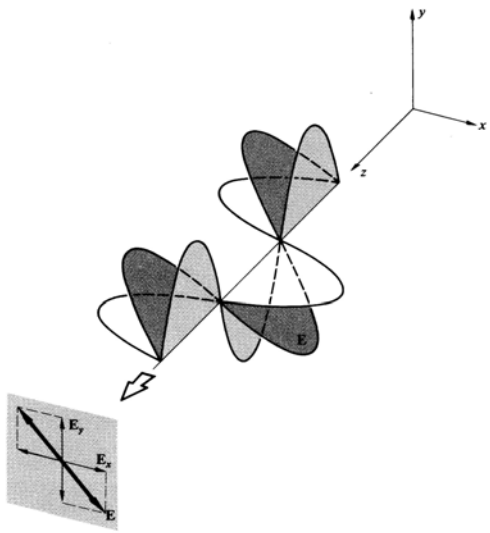
Polarization Light



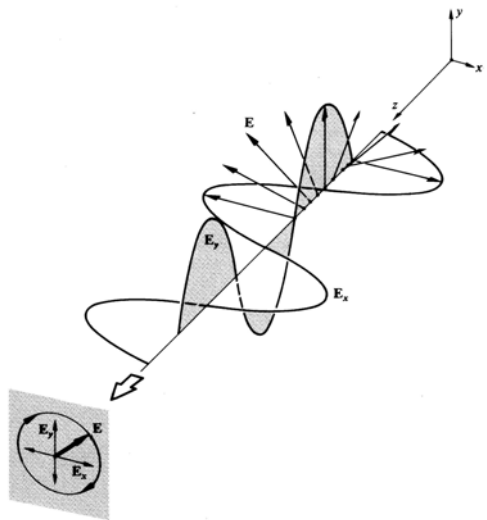


Source: Nick Strobel's Astronomy Notes. Go to www.astronomynotes.com for the updated and corrected version.



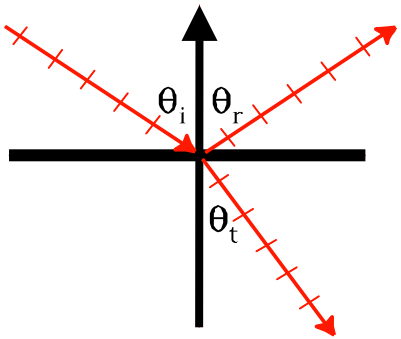


Linear light.

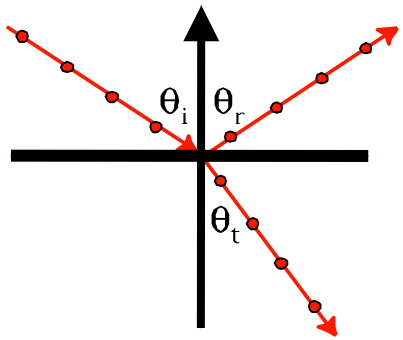


Right-circular light.

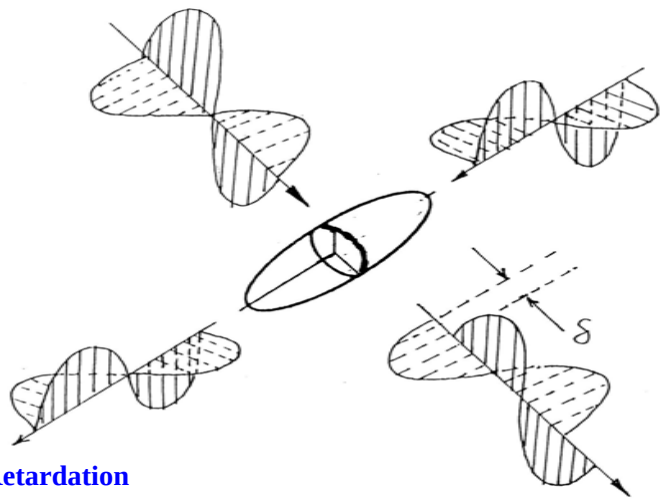
Polarization Light & Birefringence Effect



Parallel ("p") polarization

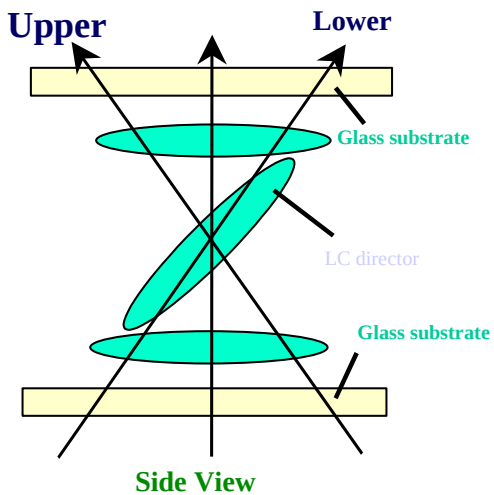


Perpendicular("s) polarization



Small Retardation
(Dark under crossed polarizers)

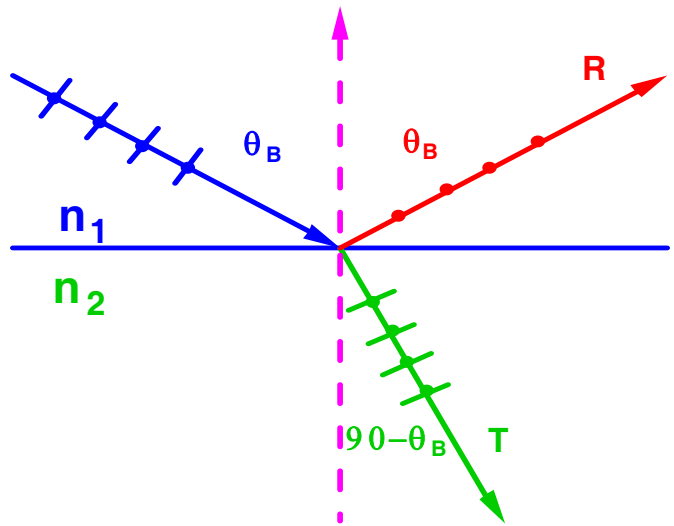
Large Retardation
(Bright under crossed polarizers)



Side View

(From CK LEE)

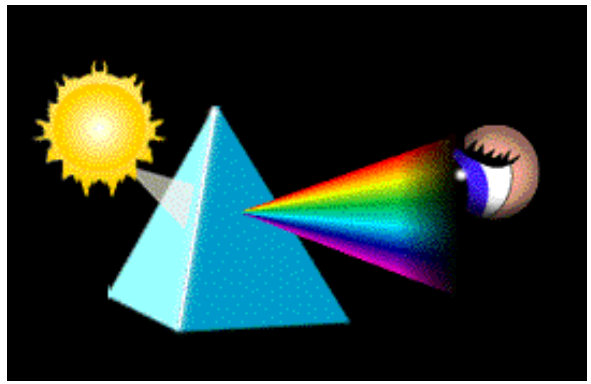
Snell's Law & Brewster Angle

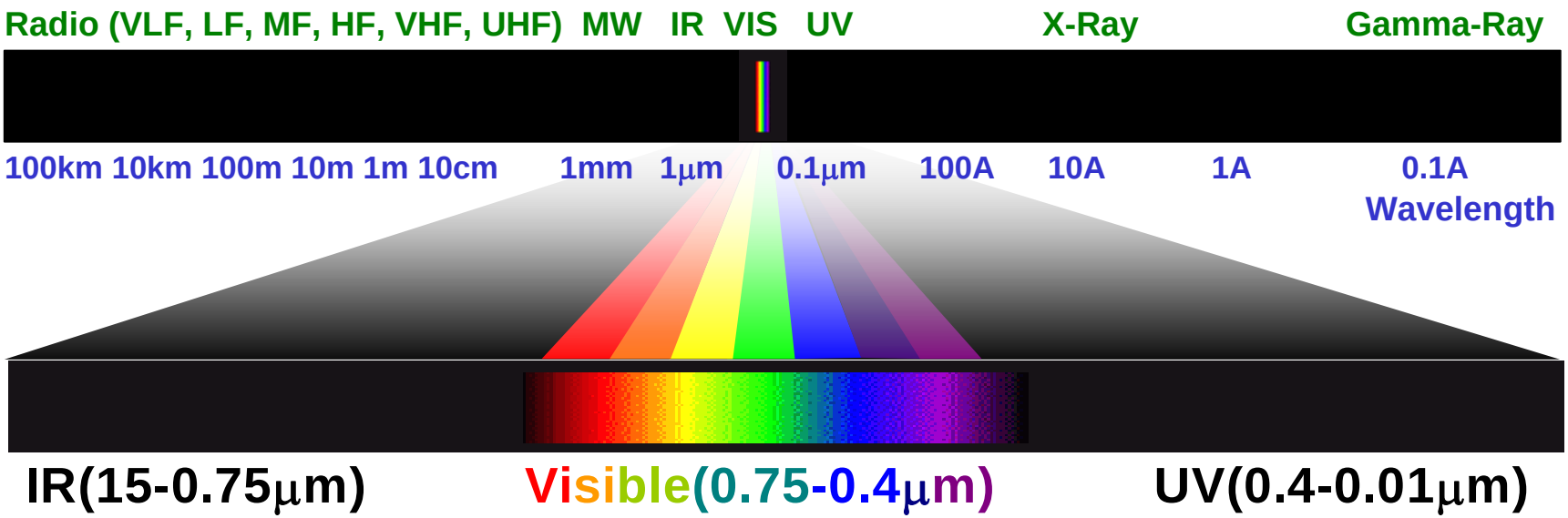


- Snell's Law: $n_1 \sin(\theta_B) = n_2 \sin(90-\theta_B)$
  So, $\tan(\theta_B) = n_2/n_1$; If $n_2=1.5$; then $\theta_B \sim 53^o$
- The **reflected** light is linearly polarized;
- The **transmitted** light is partially polarized.

(Source: S.T. Wu)

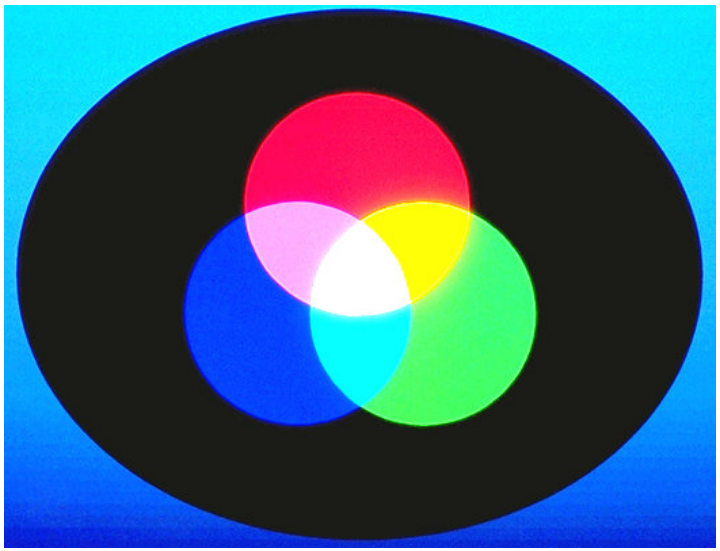
Light & Color




Radio (VLF, LF, MF, HF, VHF, UHF) MW IR VIS UV X-Ray Gamma-Ray
100km 10km 100m 10m 1m 10cm 1mm 1μm 0.1μm 100A 10A 1A 0.1A
Wavelength
IR(15-0.75μm)
Visible(0.75-0.4μm)
UV(0.4-0.01μm)

Color Generation

Addition



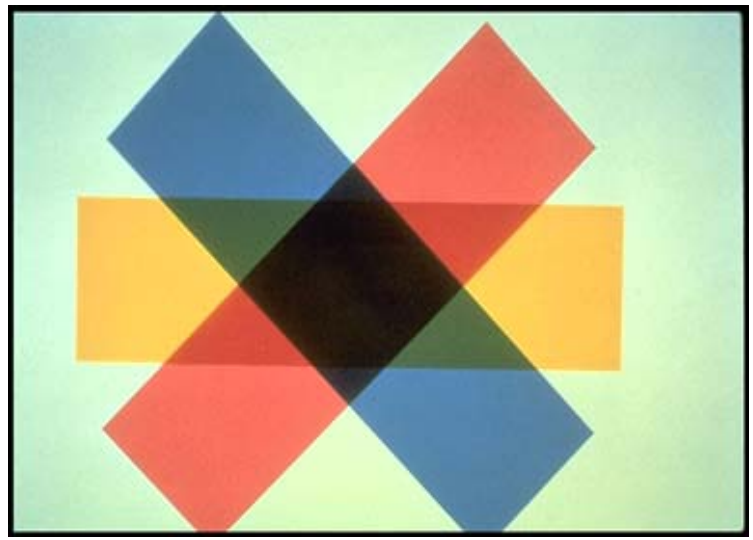
Primary Colors

Red (R) Green (G) Blue (B)

RGB

All together: WHITE

Substraction



Primary Colors:

Cyan (C) Magenta (M) Yellow (Y) and (optionally) **Black (K)**
CMYK

All together: BLACK

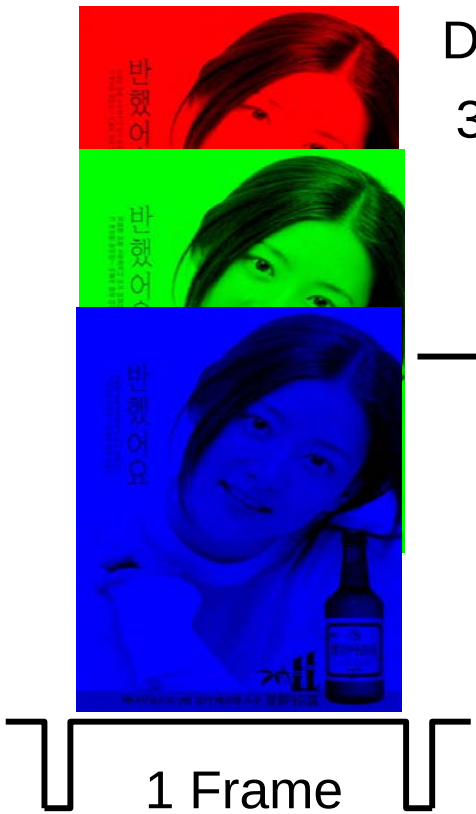
Displays

Papers

(Source: S.T. Wu)

Color Generation

3-Channel Color



Drawback：

3 pixels needed

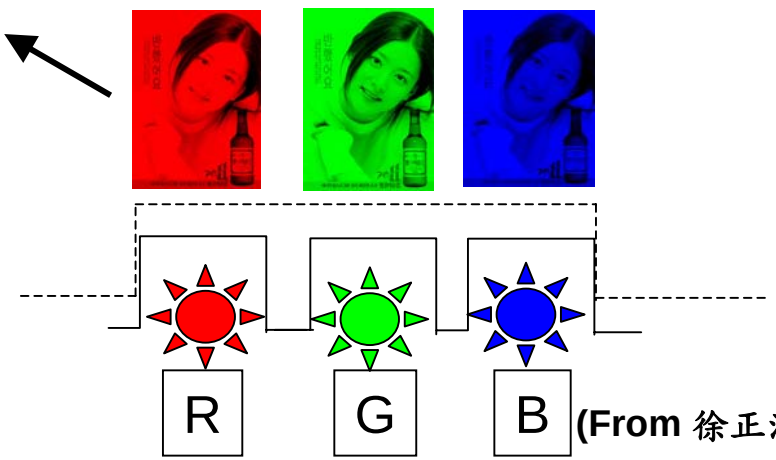
Color Sequential

Drawback：

Frame rate: 180Hz

→ f_{CLOCK} 變3倍

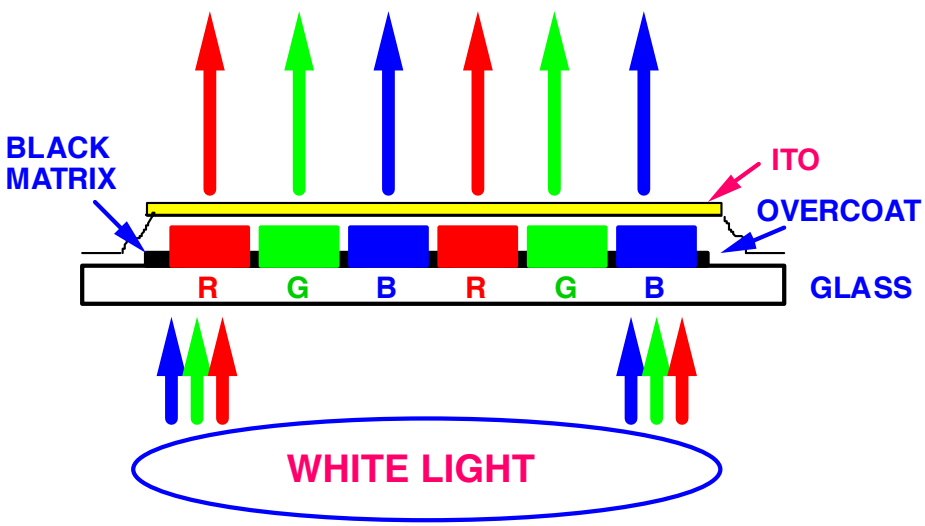
1 Frame (1/60 Sec)



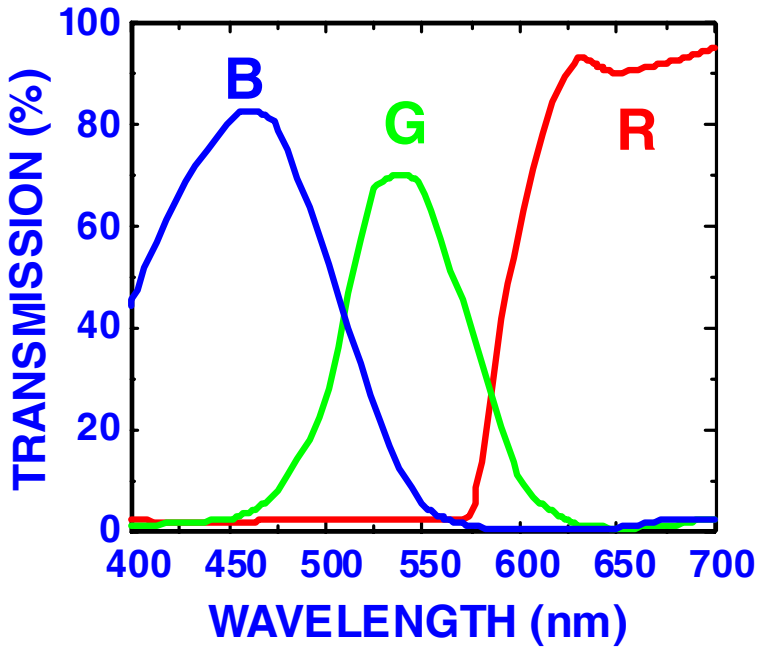
(From 徐正池)

Color Filters

A. Structure



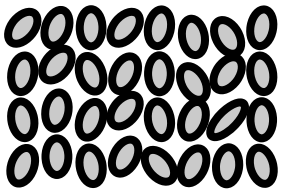
B. Transmission



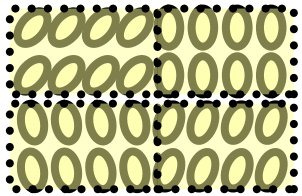
- **Light efficiency: 0.3x0.8~24%**
- **Resolution: 3 sub-pixels form a pixel**
- **Not preferred for projection displays**

(Source: S.T. Wu)

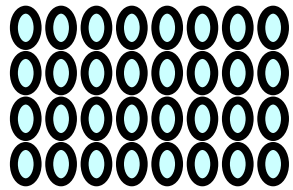
Types of Silicon



Amorphous Si



Poly-Si



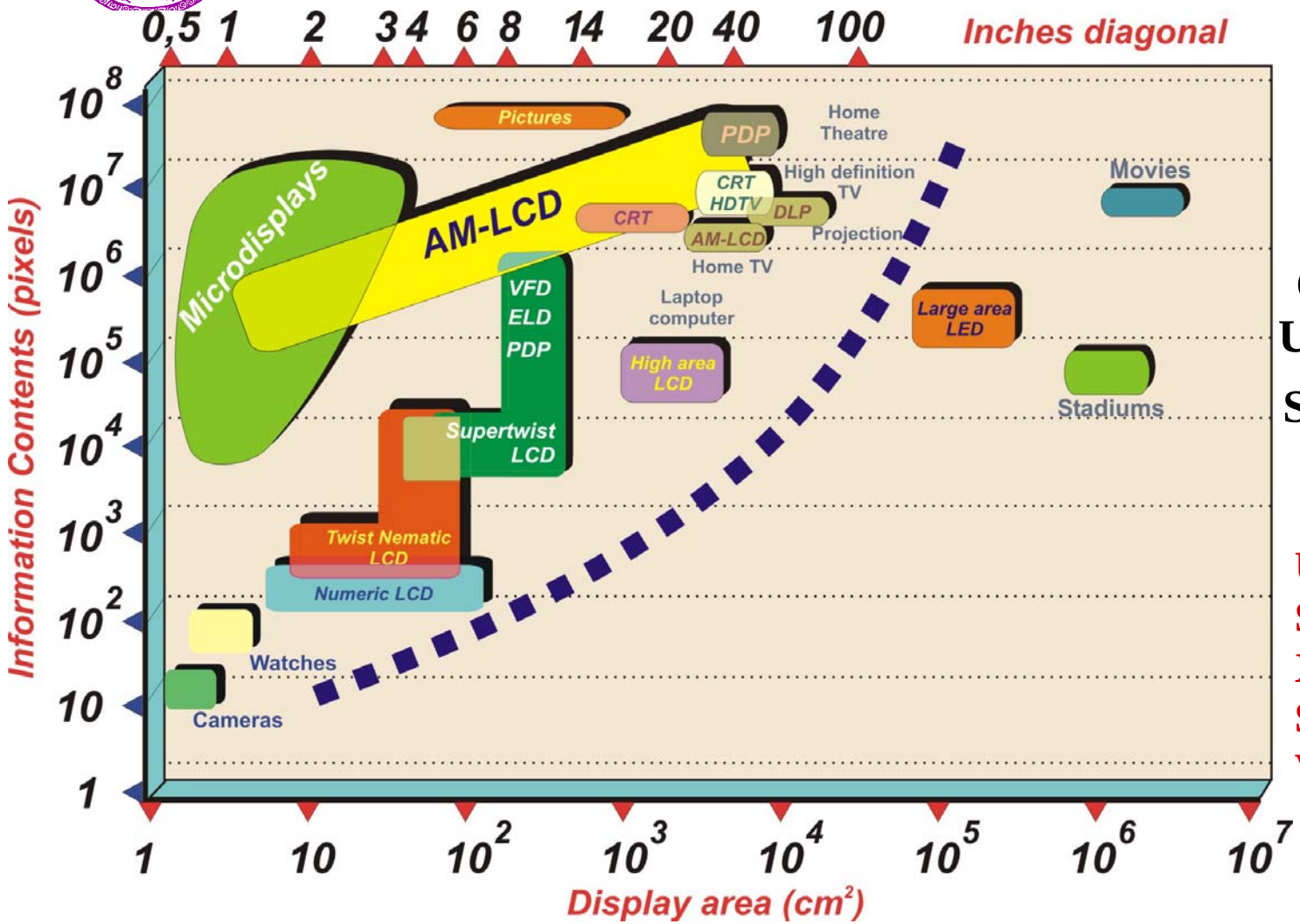
Single Crystal Si

Parameters	a-Si	p-Si	c-Si
1. Electron Mobility:	1	10^{2}	10^{3}
2. TFT OFF-current:	10^{-12}	10^{-12}	10^{-13}
3. TFT ON-current (A):	10^{-4}	10^{-4}	10^{-3}
4. Dots pitch/inch:	300	1000	2000
5. Pixel Size (μm):	80	25	10
6. Infrastructures:	Good	Fair	Ex
7. Panel Size:	L+M	M+S	S

a-Si: Large panel; p-Si: Medium; c-Si: Micro-display

(From S.T.Wu)

Display Applications by Size



解析度

QXVGA
UXVGA SXVGA
XGA
SVGA VGA
<VGA

UXGA:1600x1200
SXGA:1280x1024
XGA:1024x768
SVGA:800x640
VGA:640x480

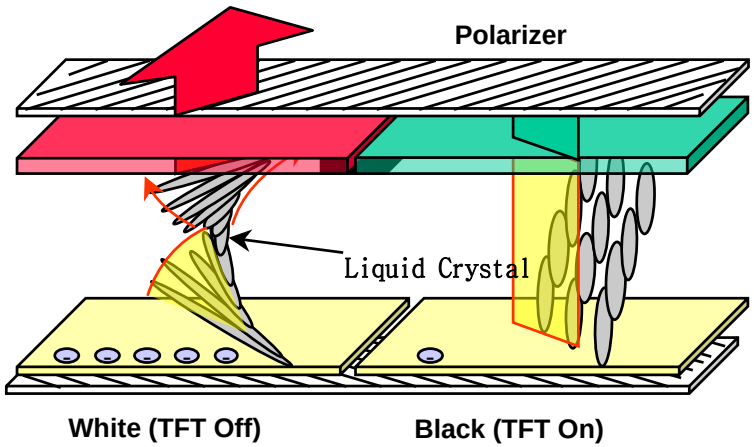
Paradigm Shift of Display

3rd wave: Unification of Information & Communication, Digital TVs, Wireless digital networks.

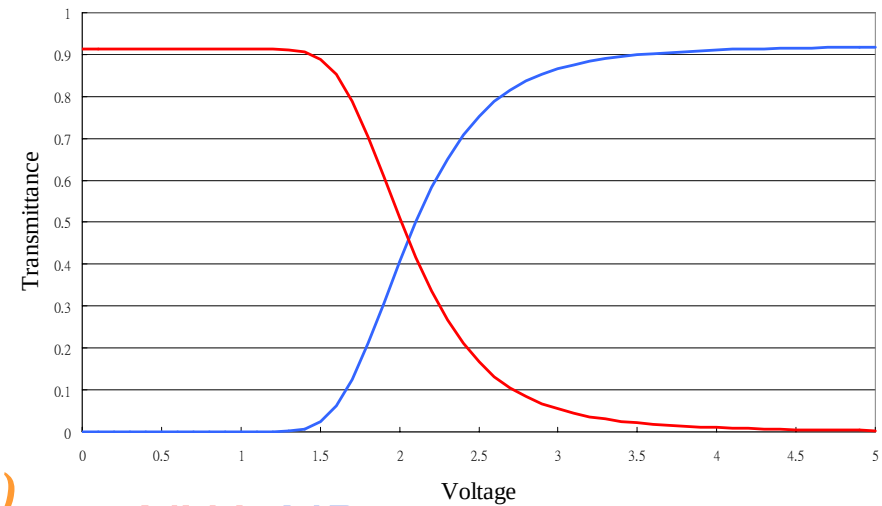
（Source：吳詩聰）

LCD Display Principle

Ex. TN Mode



V-T Curve



LC為一光閥:控制通過光的強弱(本身不發光)

NW NB

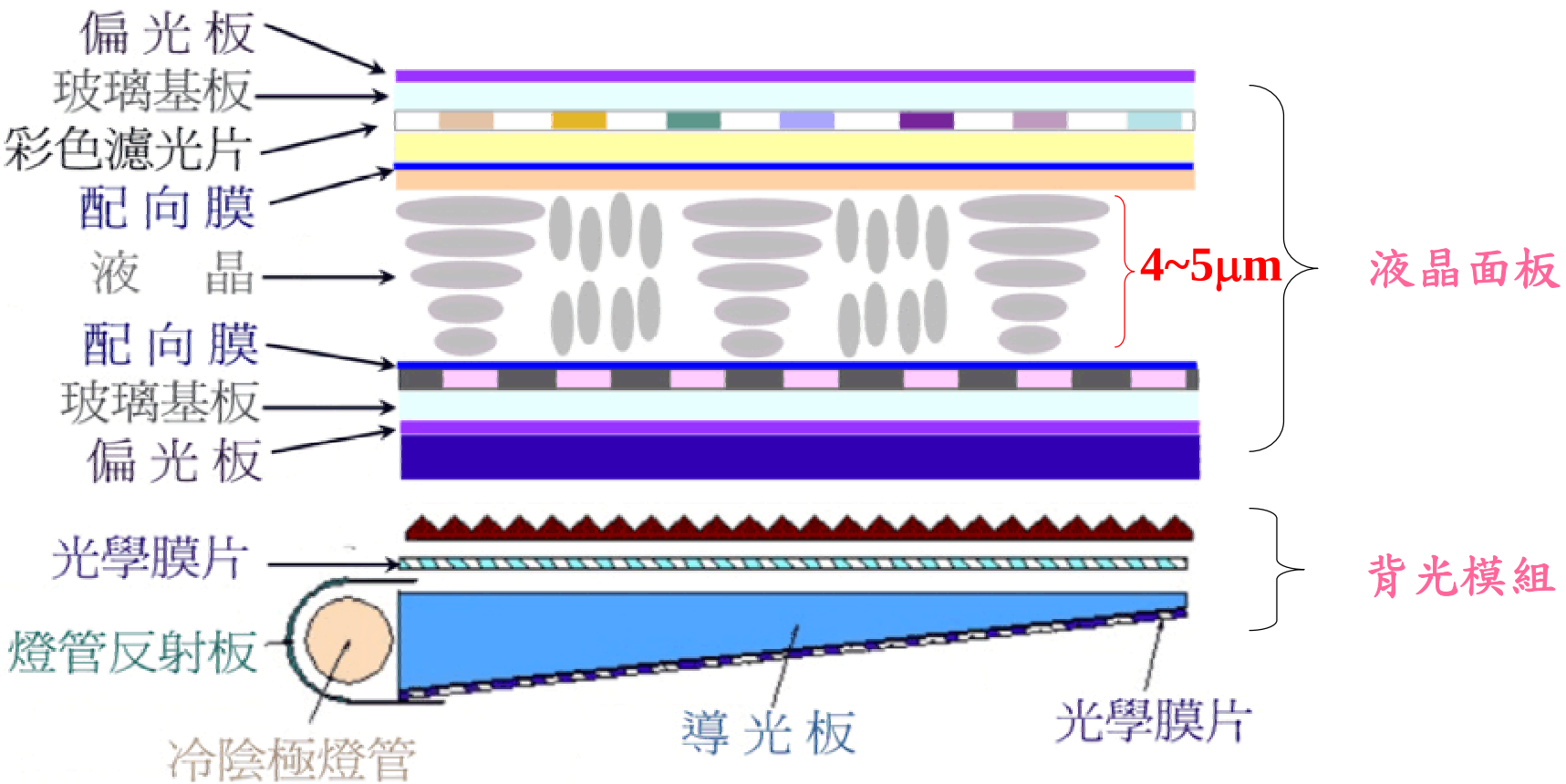
外加電壓 ⇨ 改變液晶的排列方式 ⇨ 造成光極化態的改變

再搭配Polarizer或補償膜 ⇨ *完成亮暗顯示的效果*

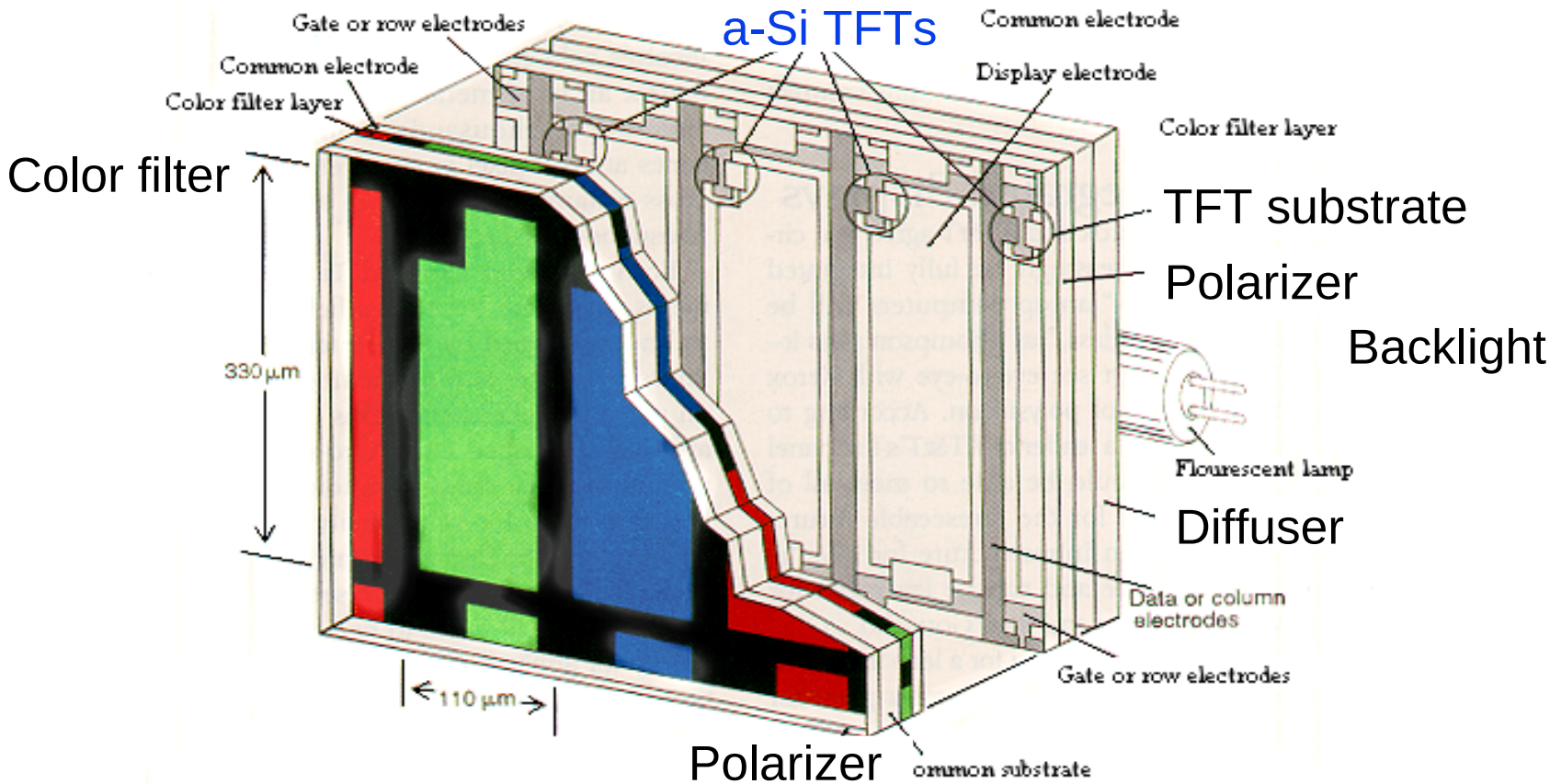
(from 翁逸君)

TFT-LCD功能說明

液晶分子無法自主發光,需要背光源方能看到LCD面板上所顯示之內容。



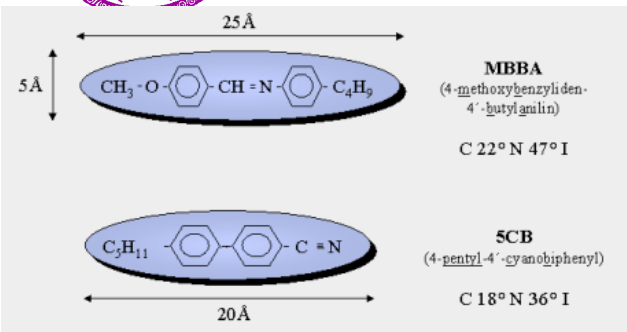
TFT-LCD



Each pixel is independently driven by a TFT

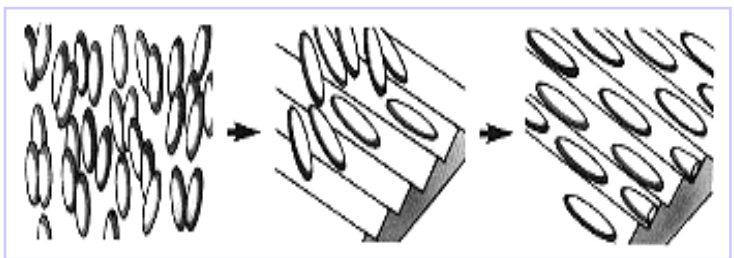
（Source：吳詩聰）

Liquid Crystal (I)



分子量: 300~800

(0.3~0.4g for 12.1”LCD)

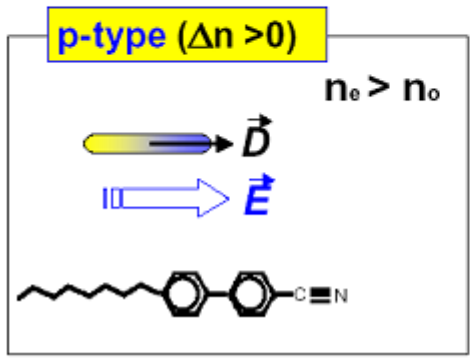


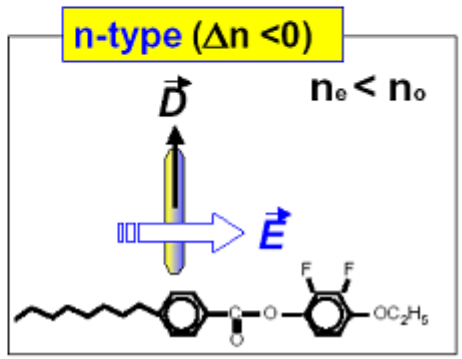
Birefringence: $\Delta n = n_e - n_o$

Dielectric Anisotropy: $\Delta\varepsilon = \varepsilon_e - \varepsilon_o$

n_o ε_o n_e ε_e

$\vec{D}$(Director)





Temperature ↗ Δn ↘, Δε ↘, viscosity ↘, Kii (elastic constant) ↘ etc.

Viscosity influence the LC filling and response time

Liquid Crystal (II)

Response time

Rise time: $\tau_r \sim \gamma d^2/(\varepsilon_0 \Delta\varepsilon(V^2-V_c^2))$

Delay time: $\tau_d \sim \gamma d^2/(\varepsilon_0 \Delta\varepsilon V_c^2)$

d↘, γ ↘, $\Delta\varepsilon$ ↗,
⇨(τ_r ,τ_d ↘).

where

D: cell space

γ : viscosity

V_c: threshold voltage

Operating Voltage: $V = (K/\varepsilon_0\Delta\varepsilon)^{1/2}$; here

$K=\pi^2 K_{11}+\phi(K_{33}-2K_{22}) +4\pi\phi K_{22}\, d/p$

$\Delta\varepsilon$ ↗ ⇨V↘.

E_{ii}: elastic constant; p: pitch

HTPS vs. LTPS

HTPS: High Temperature Poly-Si

LTPS: Low Temperature Poly-Si

	Process Temperature	Poly-Si Formation	Gate Oxide Formation	Substrate	Cost
HTPS	> 900°C	Solid Phase Crystallization	Thermal Oxidation	Quartz	High
LTPS	< 600°C	Excimer Laser Annealing	Deposition	Glass	Low

(From 徐正池)

Types of Display

- Transmissive
  - High Temperature Poly-Si TFT LCD
  - Low Temperature Poly-Si TFT LCD
  - Liquid Crystal on Silicon
- Reflective
  - Liquid Crystal on Silicon
  - Digital Micromirror Device
- Emissive
  - Organic LED

(From 徐正池)

Indoor

Transmissive LCD Reflective LCD

Outdoor

Reflective LCD Transmissive LCD

(from 翁逸君)

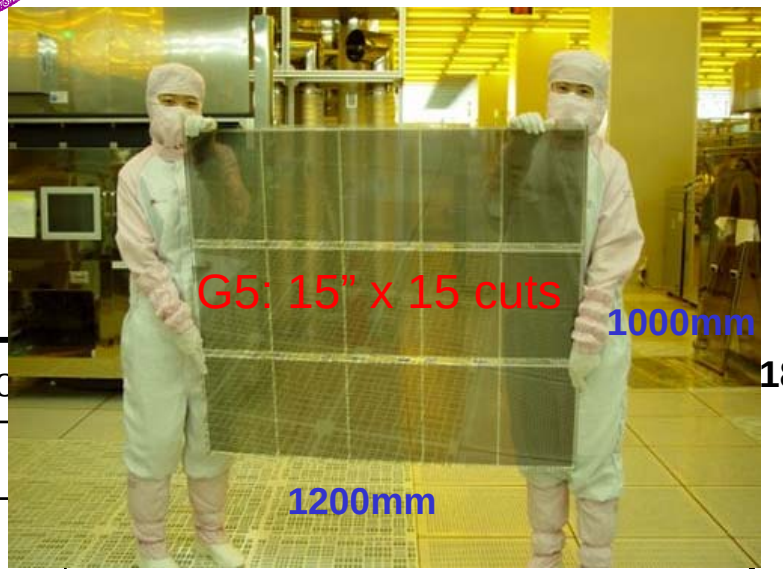
Viewing Angle Problem of TFT-LCD

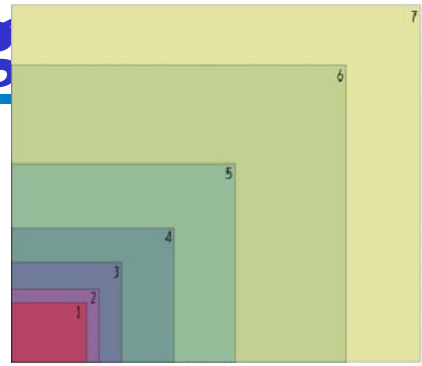
TN type	Super MVA
L/R/U/D: 60/60/40/60 (CR>10)	L/R/U/D: 85/85/85/85 (CR>20)
Gray scale inversion	All azimuth 80 (CR > 10)
High color shift	No gray scale inversion
	Low color shift

(**MVA**: multi-domain Vertically Aligned; **IPS**: in plane Switching)

(From CM 韋中光)

TFT-LCD manufacturing

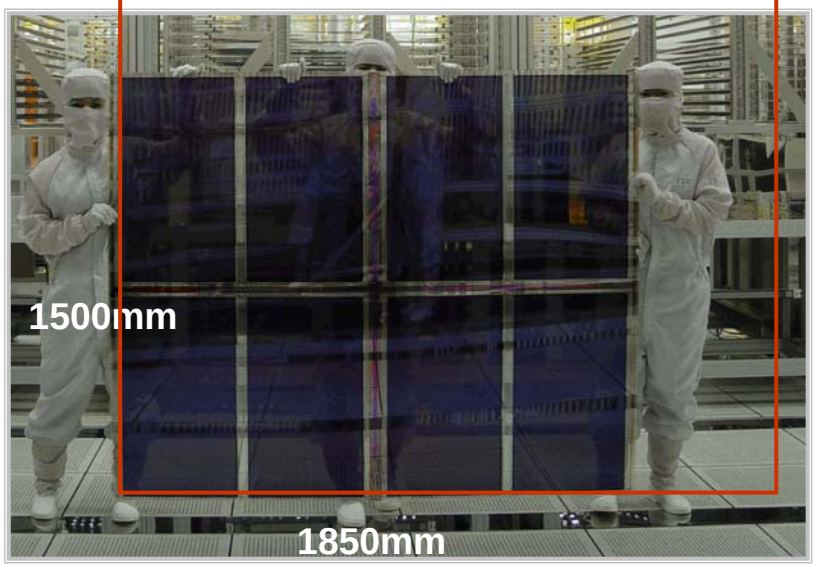




G7

2200mm

1870mm



G6: 32" x 8 cuts

Generatio	
1G	
2G	
3G	550 mm x 600/650 mm
3.5G	610 mm x 720 mm
4G	680 mm x 880 mm
5G	1000/1120 mm x 1200/1250 mm
6G	1500 mm x 1800 mm
7G	1800 mm x 2000/2200 mm

LCD manufacturing lines (I)

表一　台灣次世代顯示器生產線

廠商名稱	X(mm)	Y(mm)	Gen.	最大月產產能(k sheet)	量產時程(f)
AU Optronics (友達光電)	1100	1250	5	70	2003Q1
	1100	1300	5	70	2004Q2
	1500	1800	6	90	2005Q2
Chi Mei (奇美電子)	1100	1300	5	120	2003Q3
	1300	1500	5.5	100	2005Q1
CPT(中華映管)	1500	1800	6	30	2005Q2
Hannstar (瀚宇彩晶)	1200	1300	5	90	2004Q1
	1500	1850	6	30	2006Q1
	2120	2450	7	--	規劃中
Innolux Display(群創)	1100	1300	5	35	2004Q4
Quanta(廣達)	1100	1300	5	60	2003Q2
	1500	1800	6	90	2005Q3

資料來源：工研院IEK-ITIS計畫(2004/06)

http://www.st-pioneer.org.tw第116期93年08月號

LCD manufacturing lines (II)

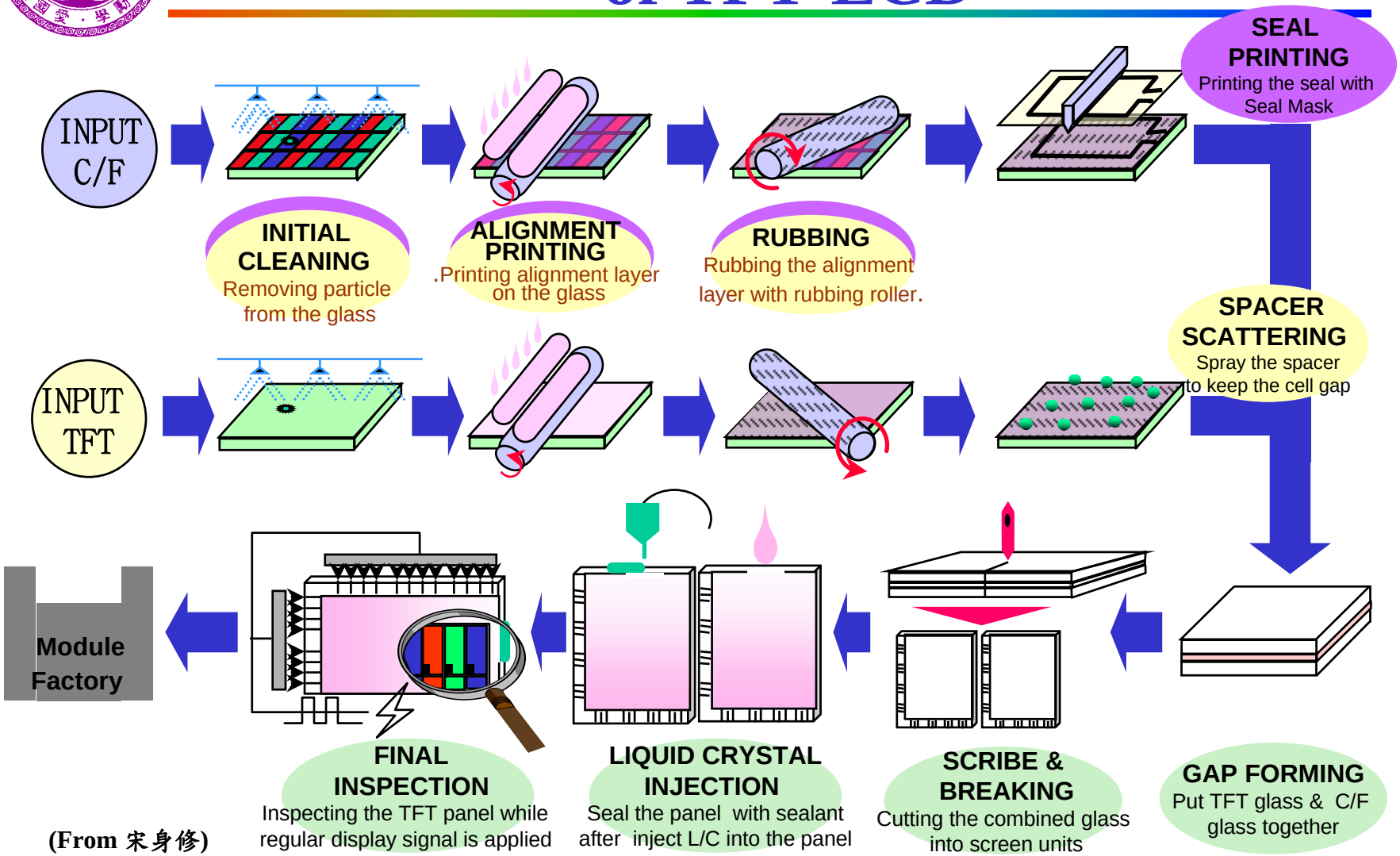
表二　主要競爭國家次世代顯示器生產線

區域	廠商名稱	X(mm)	Y(mm)	Gen.	最大月產產能(k sheet)	量產時程(f)
Japan	Sharp	1500	1800	6	45	2004Q1
		1500	1800	6	30	2005Q4
		2100	2400	7.5	30	2006
Korea	LG. Philips LCD	1000	1200	5	60	2002
		1100	1250	5	60	2003Q2
		1500	1850	6	90	2004Q4
		2120	2320	7.5	--	規劃中
	Samsung	1100	1250	5	100	2003Q2
		1100	1300	5	100	2003Q4
		1870	2200	7	100	2005Q2
	S-LCD	1870	2200	7	0	規劃中
China	BOE-Hydis	1100	1300	5	60	2005Q1
	SVA-NEC	1100	1300	5	45	2004Q4

資料來源：工研院IEK-ITIS計畫(2004/06)

http://www.st-pioneer.org.tw第116期93年08月號

Cell Manufacturing Process of TFT-LCD

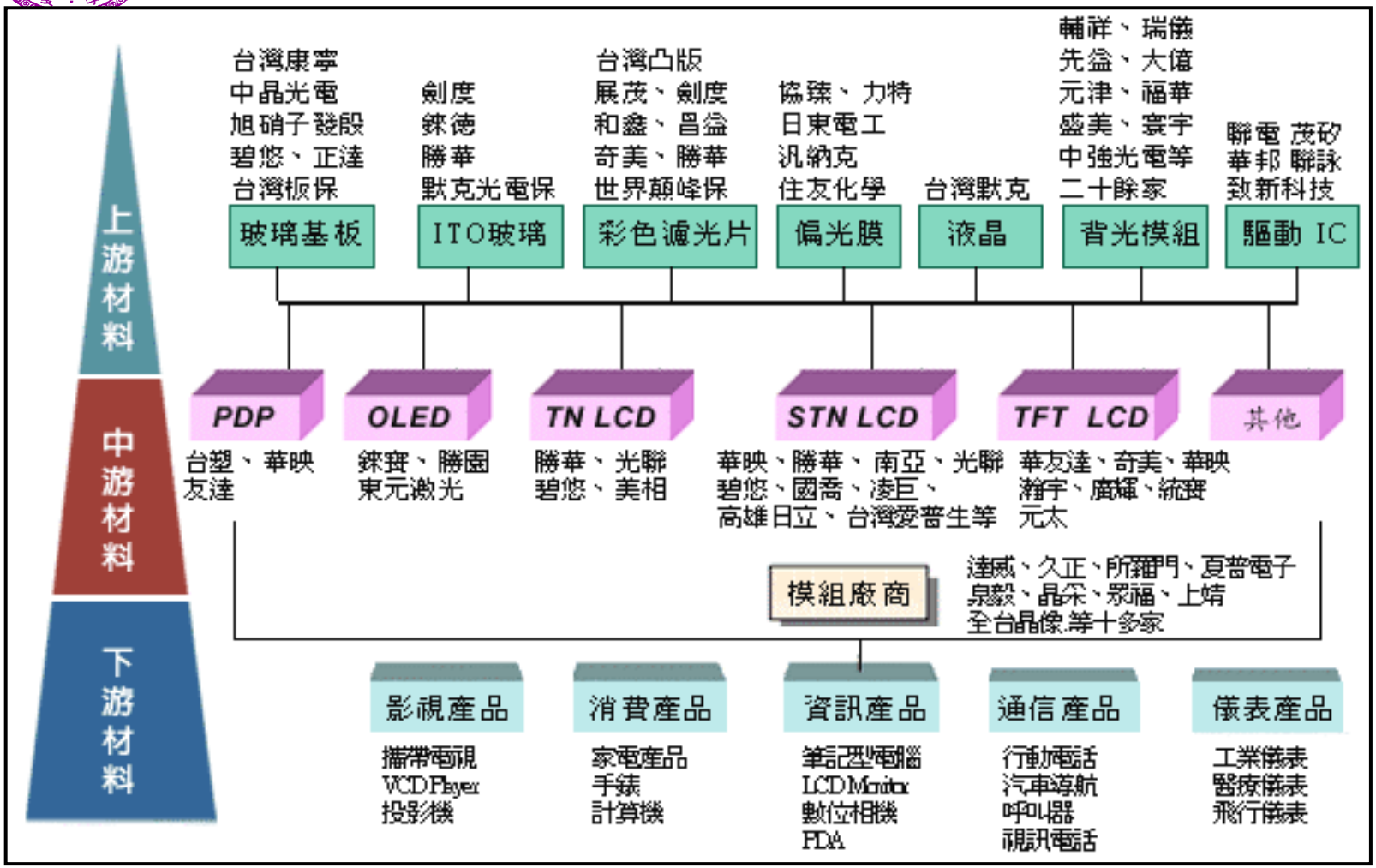


(From 宋身修)

台灣大學應用力學研究所
Institute of Applied Mechanics,
National Taiwan University

(By An-Bang Wang)

Manufacturing structure of TFT-LCD



資料來源：影像顯示產業推動辦公室

顯示技術 & TV 尺寸

- 高畫質電視
  - 平面電視
    - **LC TV** (20 ~ 60”)
    - **PDP** (30 ~ 60”)
    - **CNT-FED**
  - 投影電視 (40 ~60”)
    - **DLP (DMD)**
    - **LCOS**

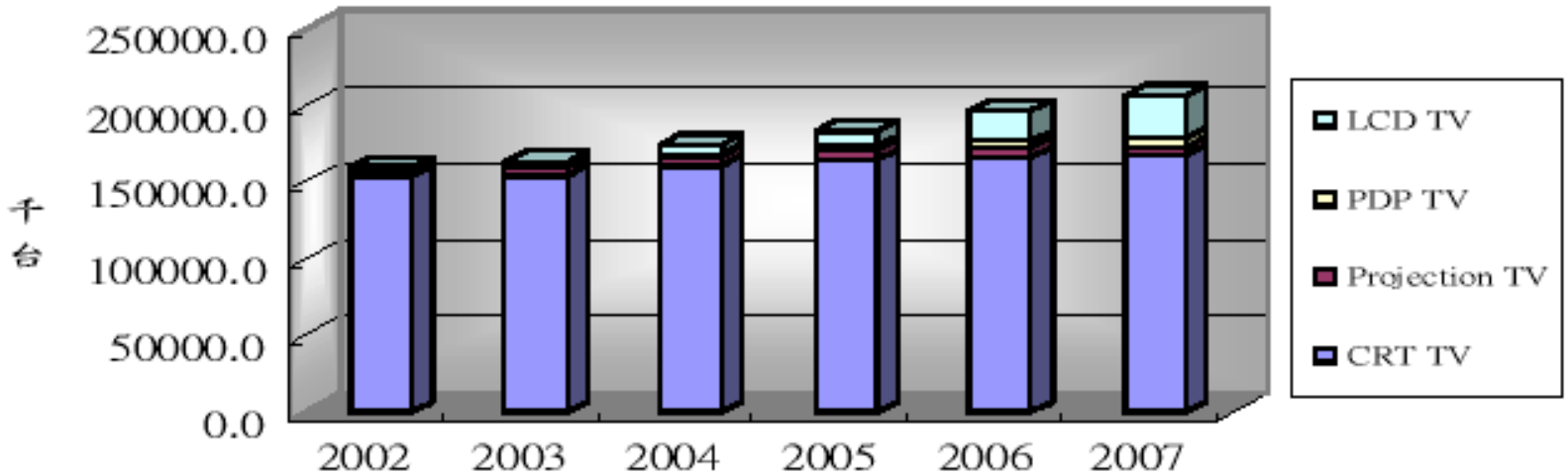
(LED Display)

Digital TV

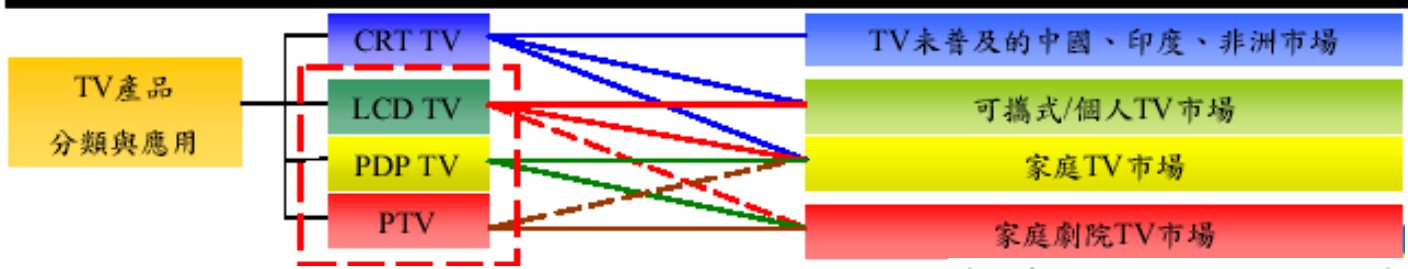
	採用標準	開播時間	類比訊號終止時間
美國	DSS/ASTC	1998	2006
歐洲	DVB-S/C/T	1998	2010
日本	DMB-T	1996	2010
中國大陸	ISDB-T	2001	2015
台灣	DVB-T	2002	2006

TV market

年度	2002	2003	2004	2005	2006	2007	CAGR
TV(單位:千台)	160,242.64	164,000.87	174,091.75	183,964.39	196,659.23	206,916.85	5.25%



	CRT TV	PDP TV	LCD TV	Projection TV
2002~2007年 CAGR	1.72%	80.42%	80.32%	4.64%

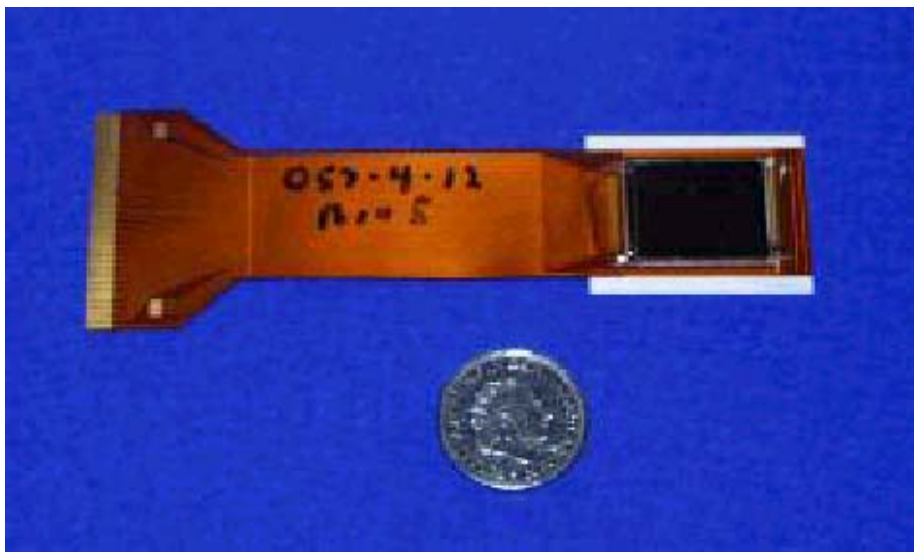


資料來源:iSuppli，工研院經資中心整理(2003/07)

（From 陳茂成）

LCOS (Liquid Crystal On Silicon)

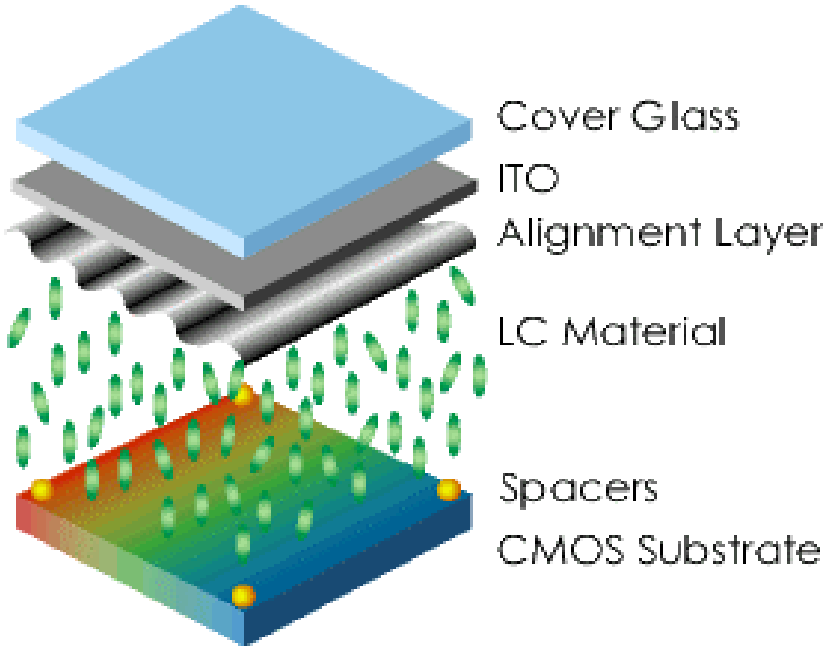
- Typical sizes of microdisplays are in the range 0.5-1.3 inch diagonal.

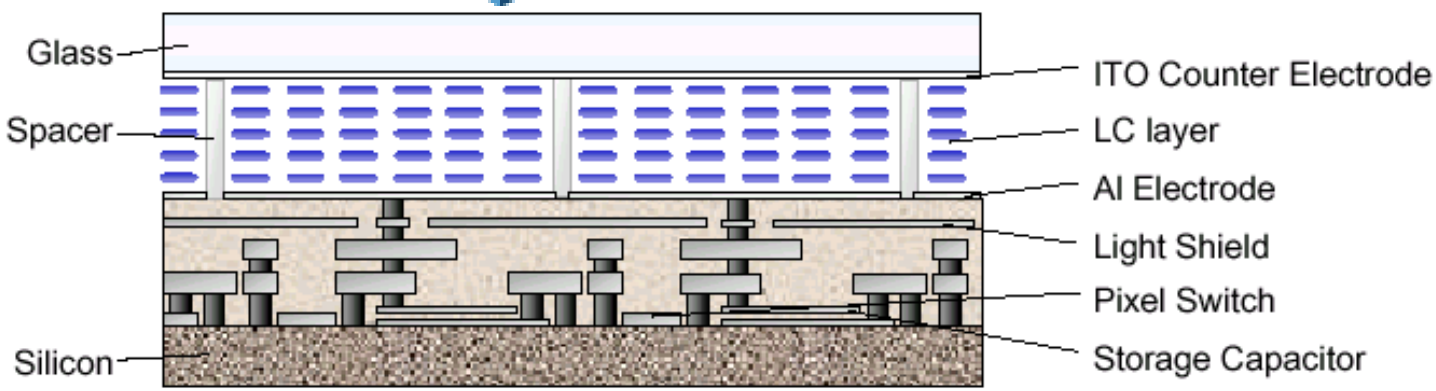


- High Electron Mobility
- High Aperture Ratio > 90%
- Very Fine Pixel Pitch
- Very High Resolution
- Low Power
- High Potential in Cost Down

Source: http://www.elis.rug.ac.be/ELISgroups/tfcg/microdis/index.html

The structure of LCOS





LCD HDTV

Samsung 82" **S-PVA mode**

1920*1080
1200:1 contrast, 92% NTSC
600 cd/m^2 brightness

AU Optronics 46”

1920*1080
800:1 contrast, 75% NTSC
600 cd/m2 brightness,
170˚, 1Q'04 MP

LCD TV, Monitor, Notebook Trend

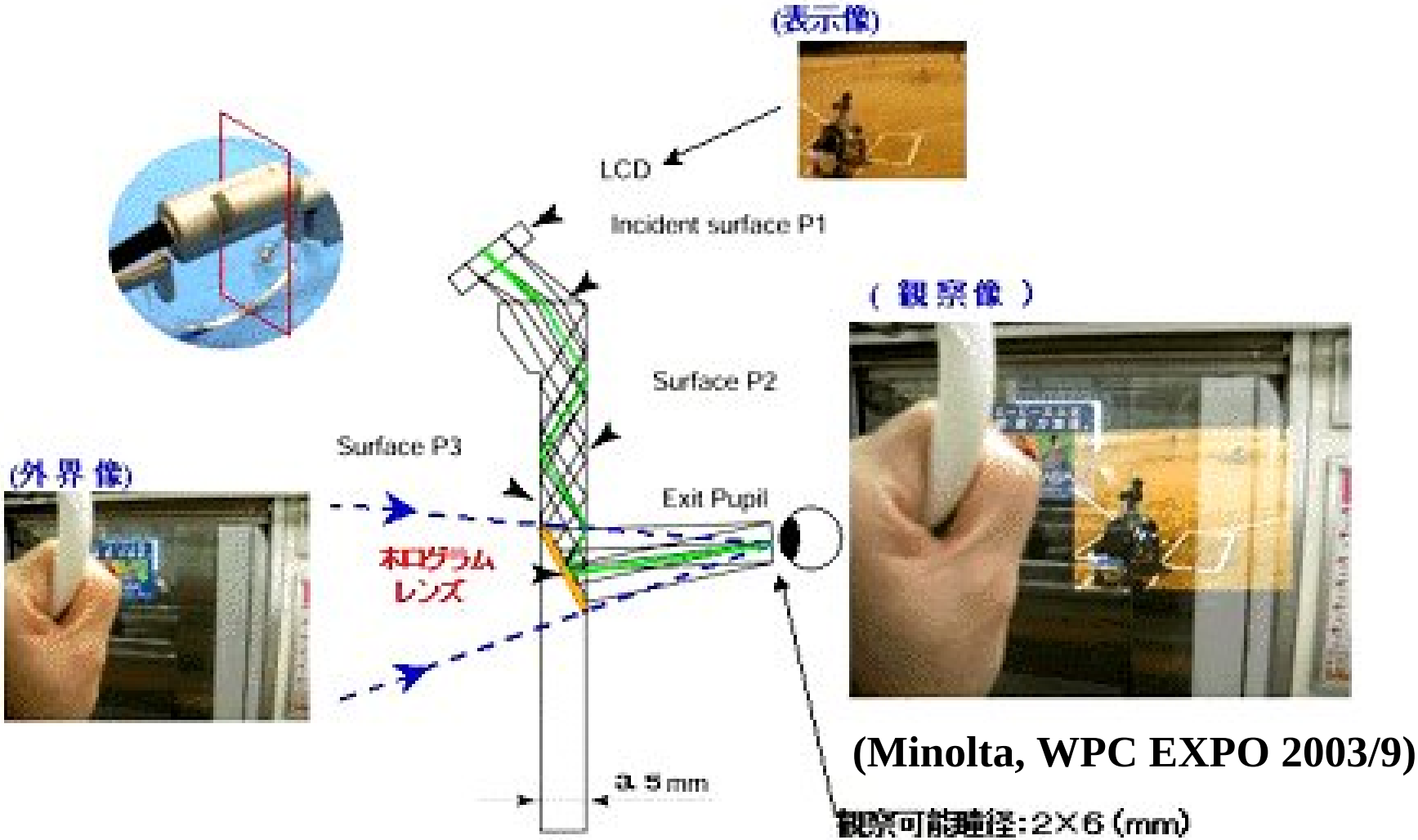
規　格	TV	Monitor	Notebook
Resolution	WXGA → HDTV	SXGA → UXGA	SXGA+ → UXGA
Size	15” ~ 45”	15” ~ 20”	14.1 ~ 15.x
Color gamut	72% NTSC→ 80% EBU-CF	(65% NTSC)	(65% NTSC)
Response	16.7 ms (Gray-level) → 8 ms (Gray-level)	23 ms (on-off) → 16.7 ms (Gray-level)	23 ms (on-off) → 16.7 ms (Gray-level)
Brightness	≥450nits 直下式	250~350 nits	250nits (High Aperture Ratio Pixel)
Weight	X	X	Lighter and lighter
Application		Monitor/TV	Multimedia/DVD

EBU-CF (European Broadcasting Union Color Filter) - Toppan

Micro Display

Mobile Computing

Holographic See-through Browser



(Minolta, WPC EXPO 2003/9)

Data projector

- The size-limit of the CRT-TV ~ 40”, (> 100kg)
- Projection type is suitable for the large size display, e.g., 40“~60” (or more)
- Advantages of the data projector (in comparison with the RGB-CRT projector):
  - small size, light
  - high lumination (ANSI > 800Lumens)
  - high resolution (800x 600SVGA, 1024 x 768XGA)
  - lower price
  - user-friendly

VGA:640x480
SVGA:800x640
XGA:1024x768
SXGA:1280x1024
UXGA:1600x1200

Advantages of DLP

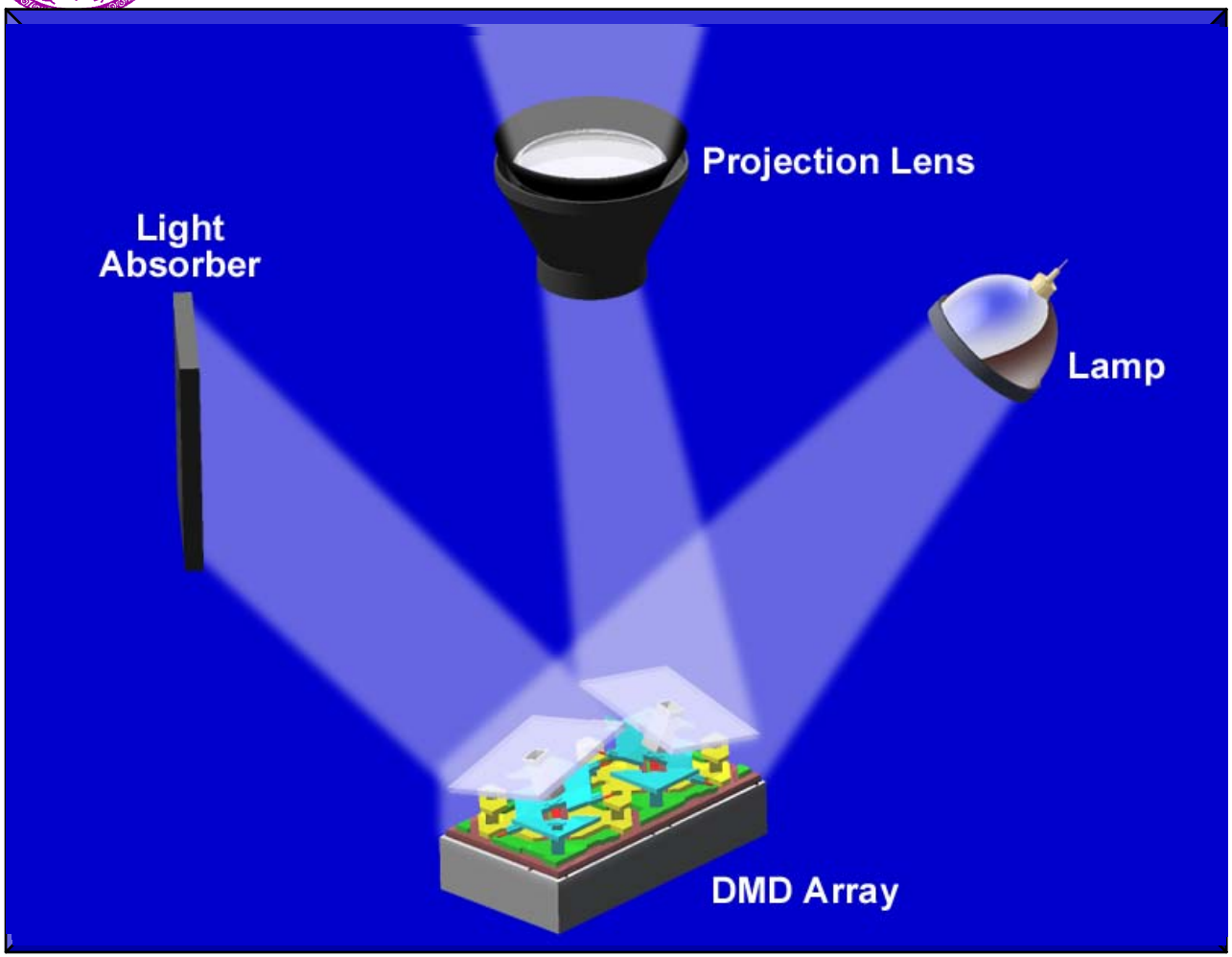
(DLP:Digital Light Processing)

- High Resolution
- High Brightness
- High Contrast Ratio
- Fast Response Time
- Flicker-Free

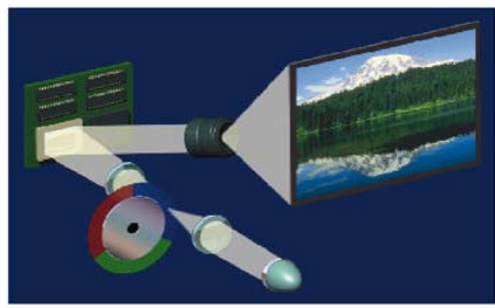
DLP™ Large Venue

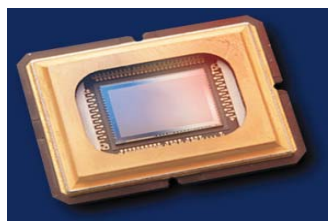
Source: Texus Instrument Inc.

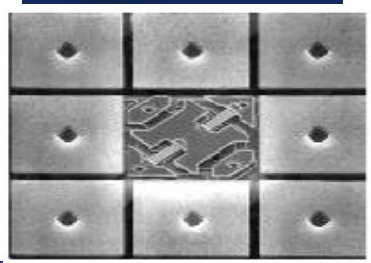
How DLP™ Technology Works



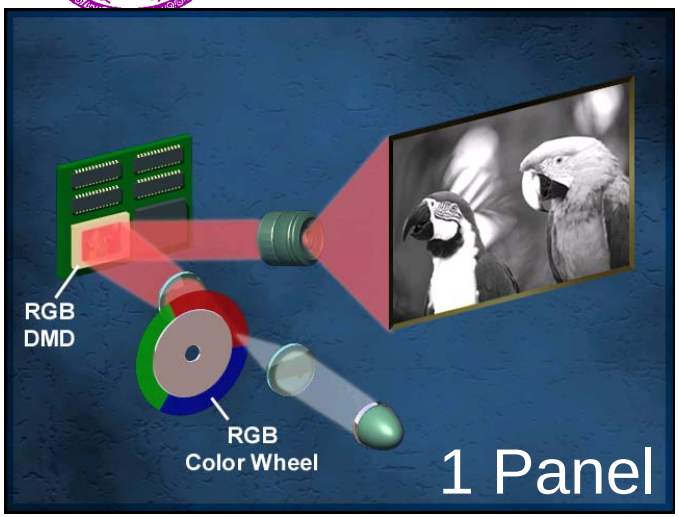
- DMD：Digital Micromirror Deivces

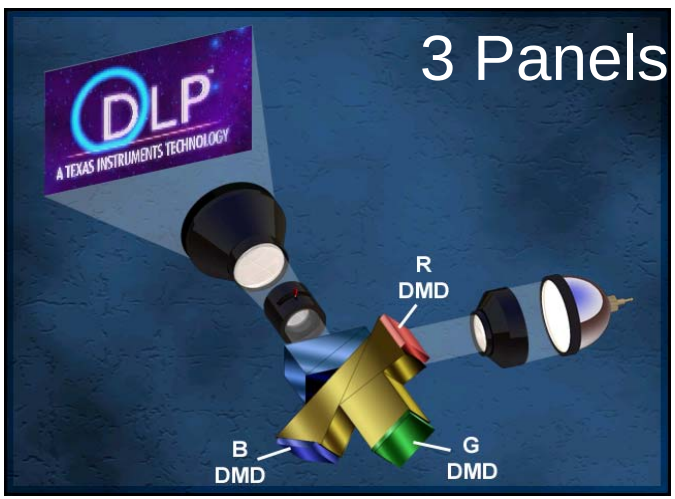






DLP Projector

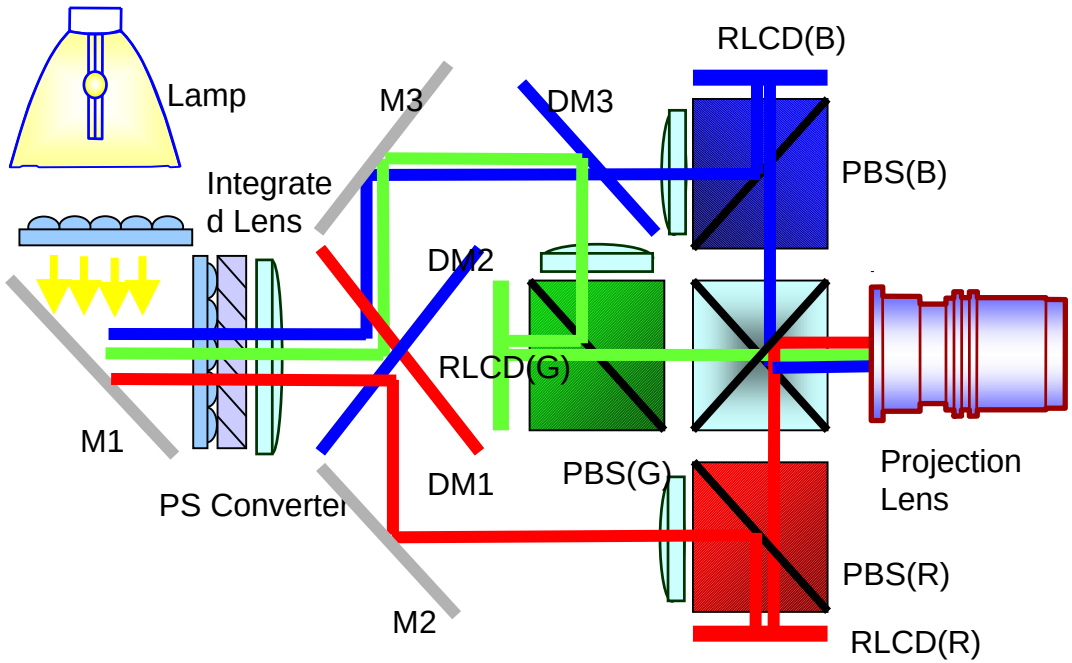




Resolution: 1280 ×1024

Pixels: 1280 ×1024

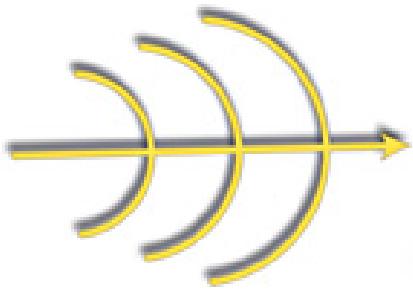
LCoS panel × 3



Where is the Next? Lighter, Brighter, and Wireless

Mobile Projection Appliance

Mobile Information Appliance



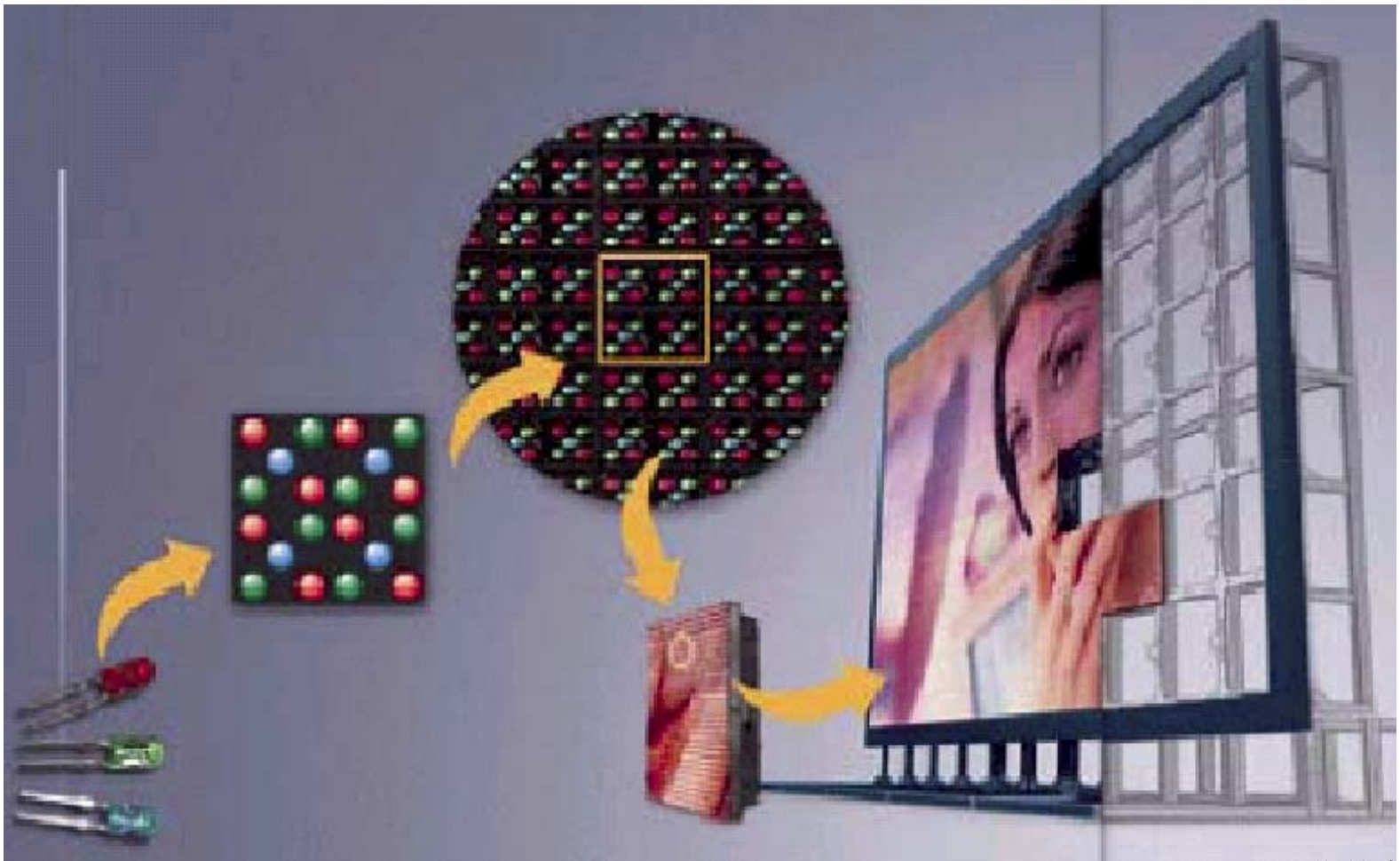
Source: Texus Instrument Inc.

Applications of LEDs

台灣大學應用力學研究所
Institute of Applied Mechanics,
National Taiwan University

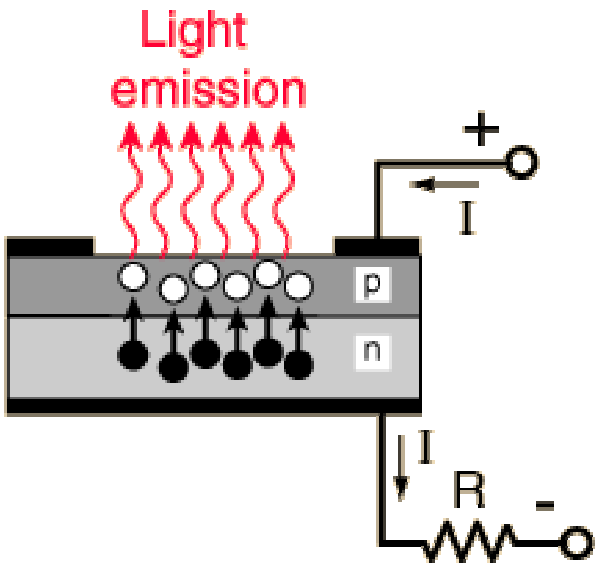
(By An-Bang Wang)

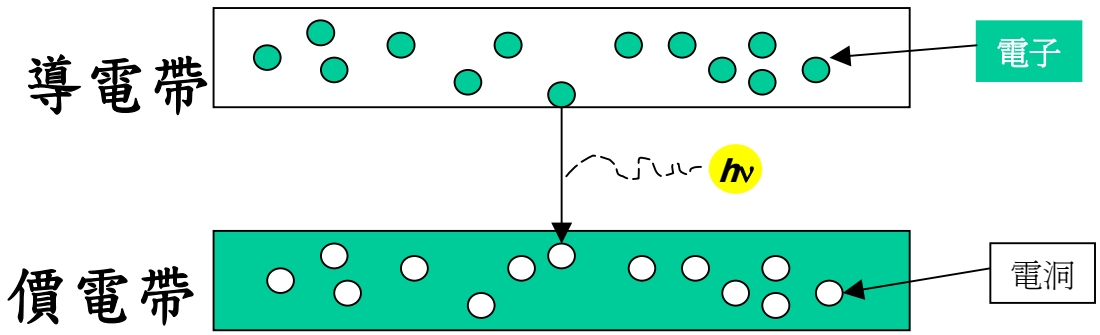
Large LED Display

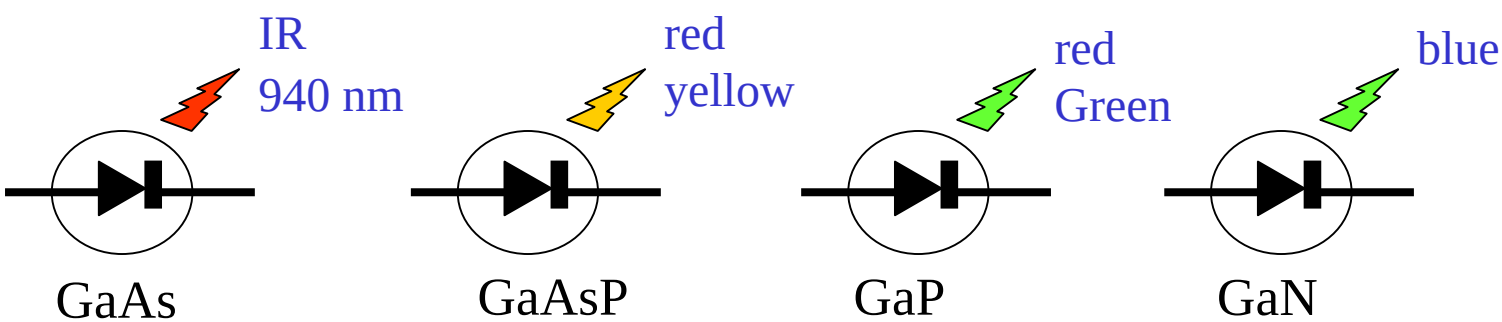


(From 許榮宗)

Light-Emitted Diodes (LED)



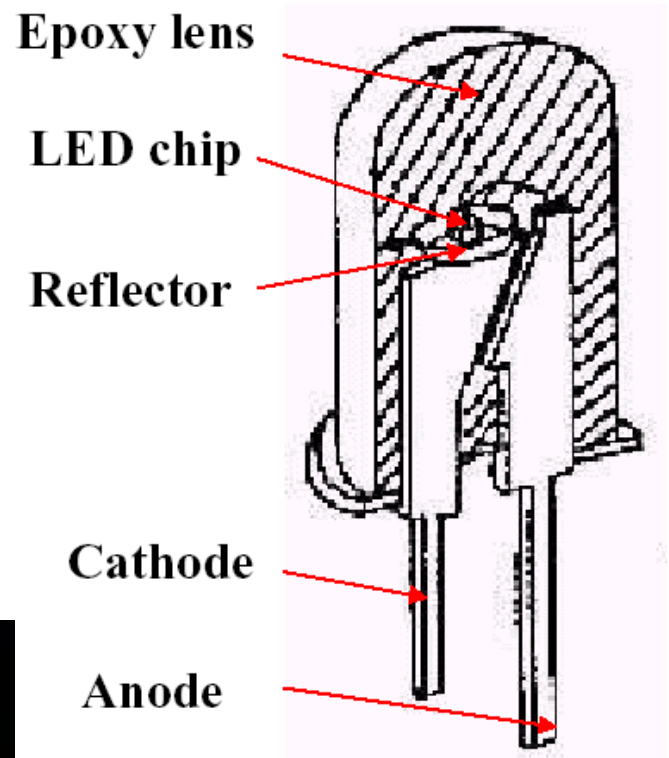




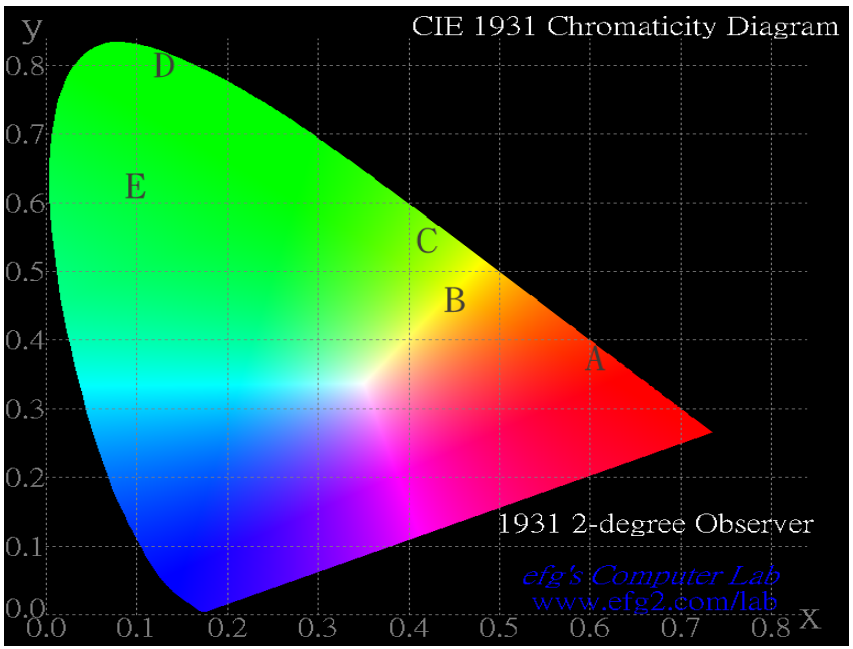
Light-Emitted Diodes (LED)

Advantages:

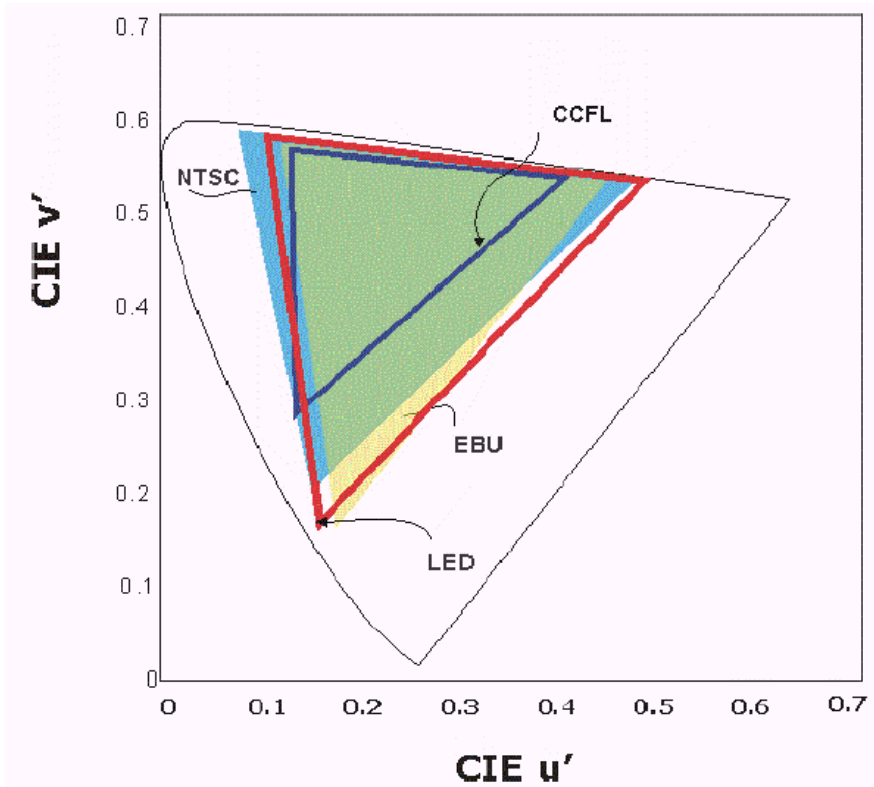
- Solid-state light source
- Small size
- No color filter needed
- Long-life (10^5~10^6 hrs)
- Low power consumption
- Fast response (~ 100 nano sec)
- High resistant to vibrations
- No mercury
- Robust



Color Gamut

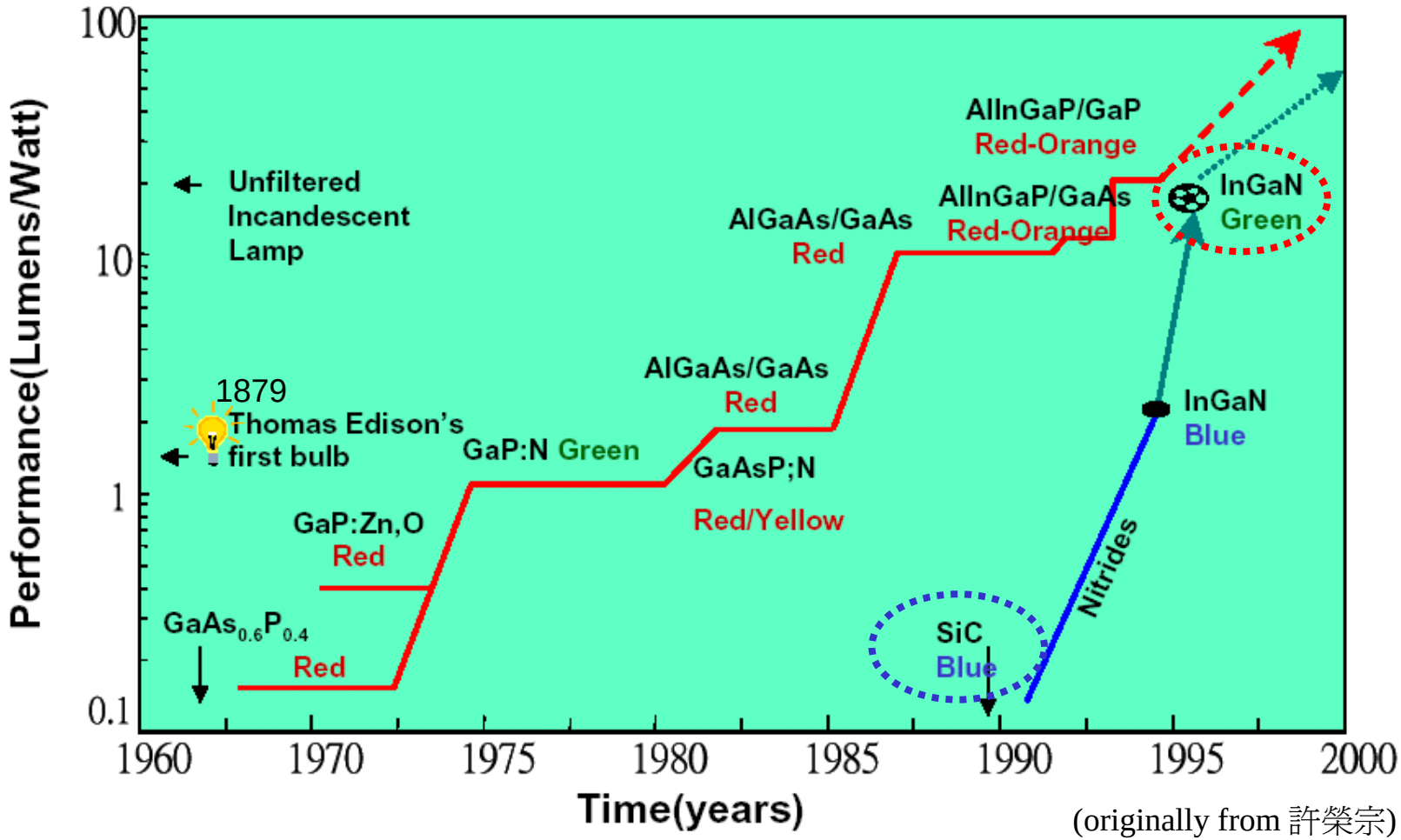


CIE 1931 chromaticity diagram of various MEH-PPV/DPO-PPV polyblends with following weight ratios: (A) 1:0 (B) 1:3 (C) 1:6(D)1:55 (E) 1:75



Evolution of LED

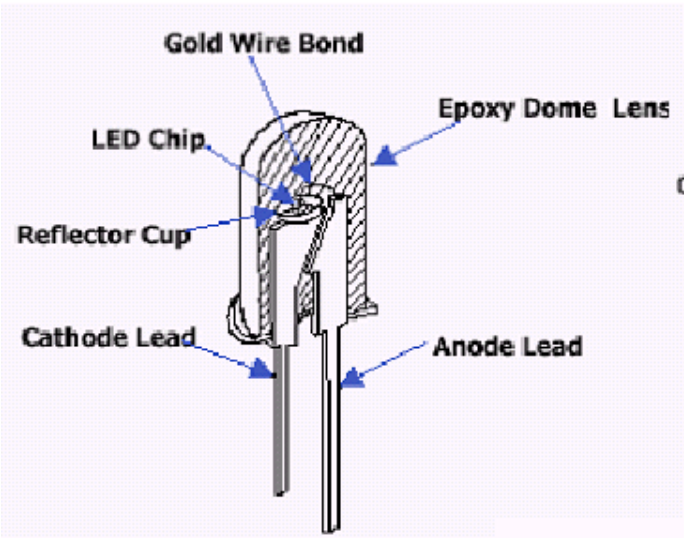
Japan: 120 lm/W @ 2010

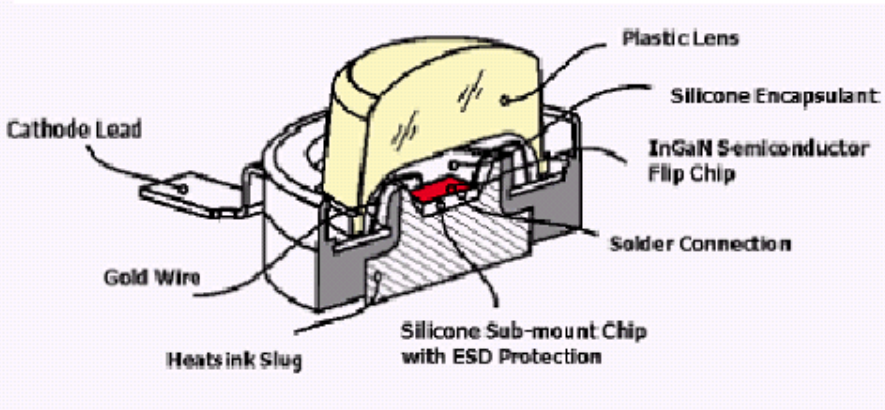


(originally from 許榮宗)

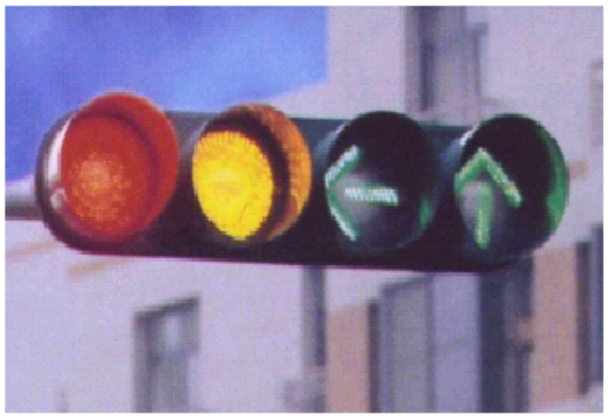
High Power LED

Tranditional LED	High Power LED
•5mm in diameter	•10-25 mm in diameter
•0.05-0.1 W	•1-5 W
•0.5-3 lm	•10-120 lm



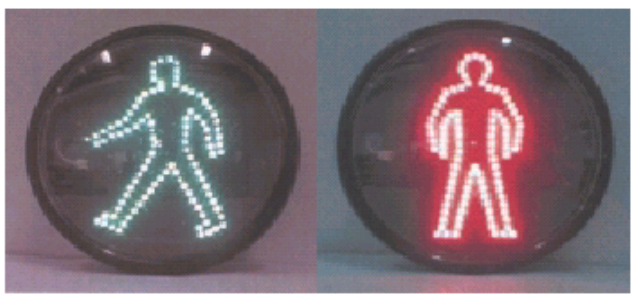


Traffic light



期初成本(12英吋燈箱):

燈泡	LED	
0.1美元	紅	65美元
	黃	75美元
	綠	160美元

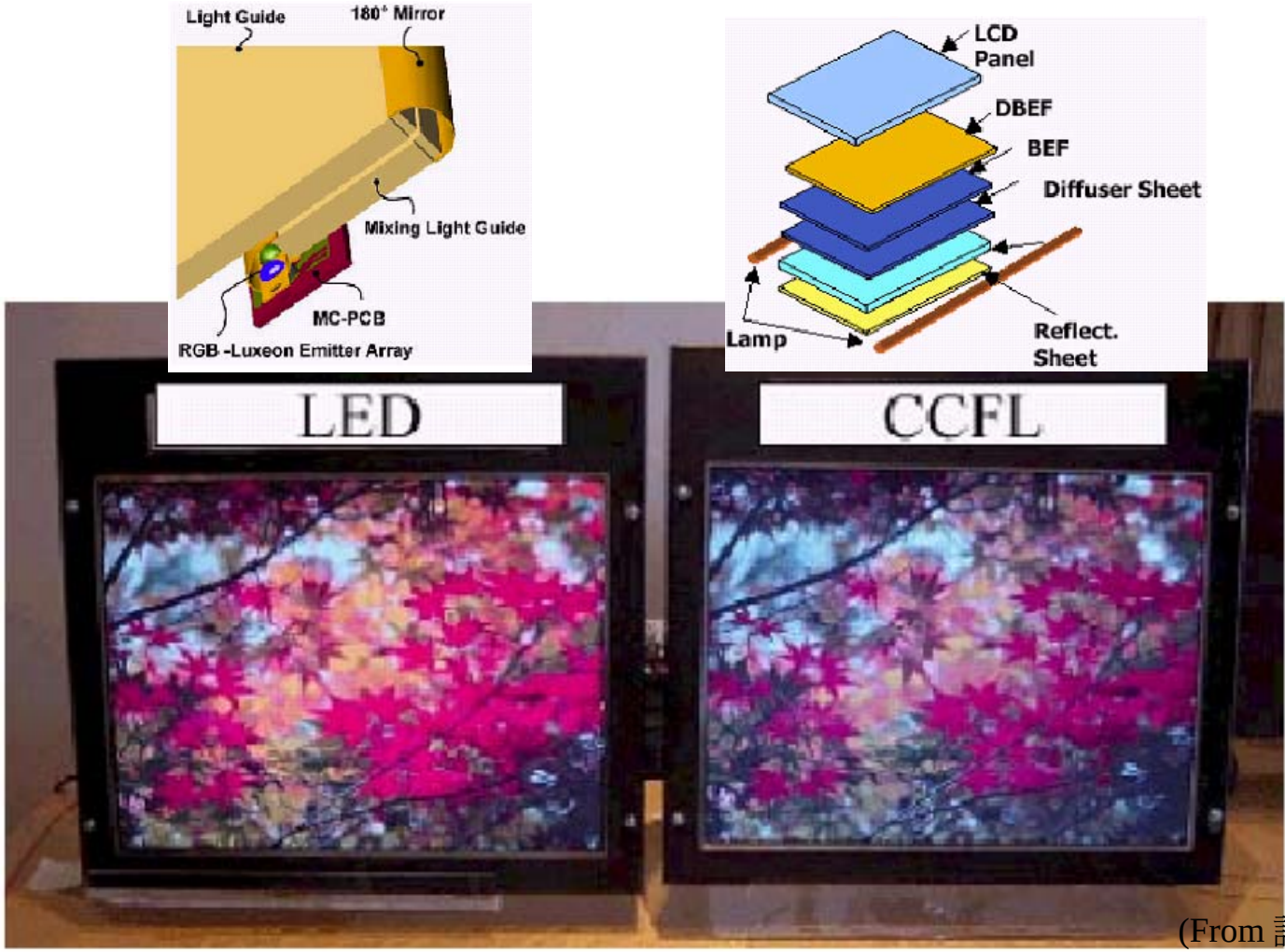


每個燈箱每年之耗能成本:
@0.11美元/kwh

燈泡	LED
61.5美元	7.4美元

(From 許榮宗)

LED backlight

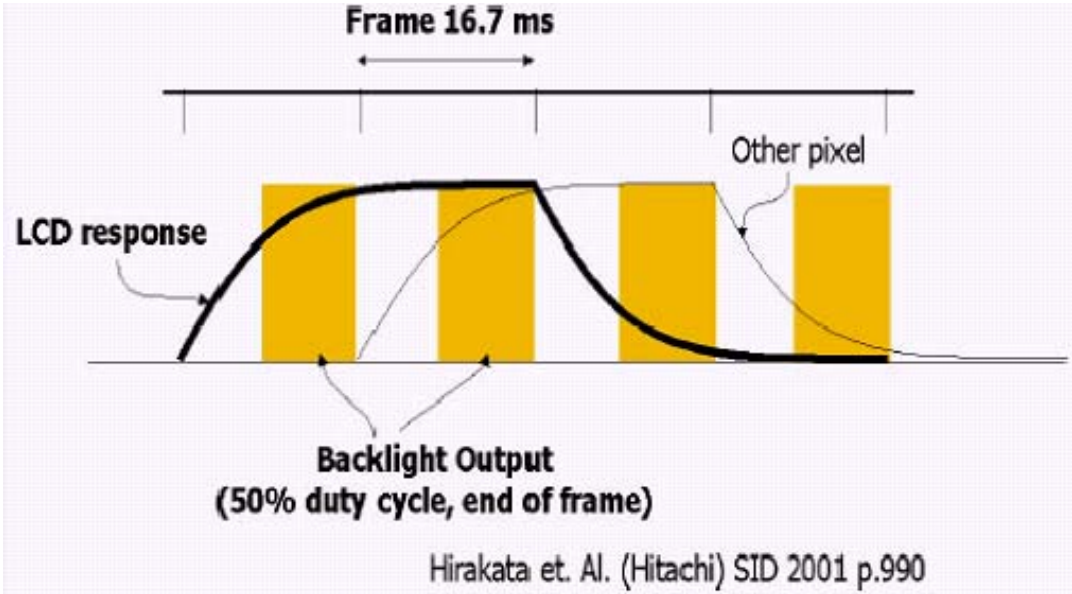


(From 許榮宗)

閃爍的背光源

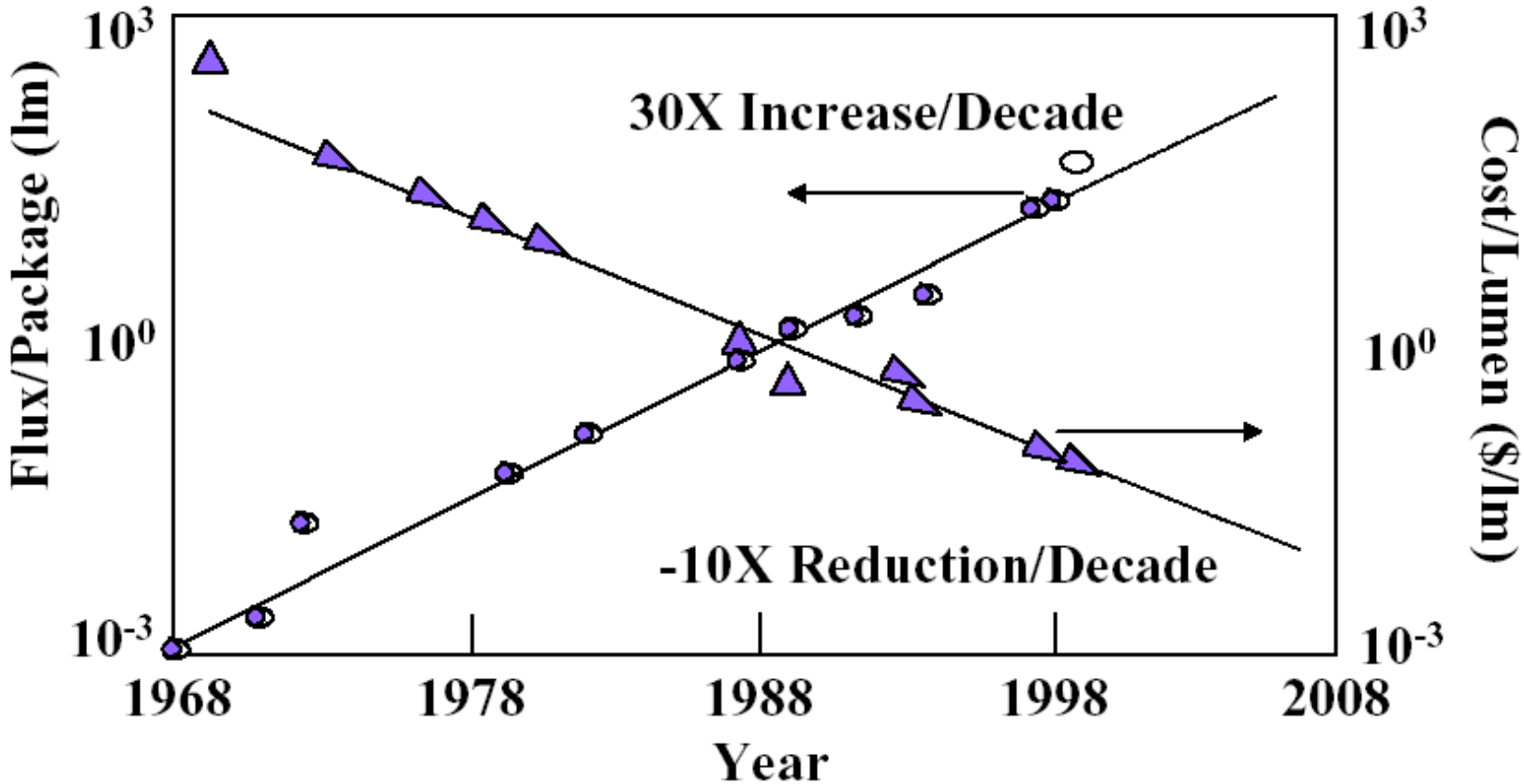
(a) With the conventional hold-type backlight.

(b) With the blink backlight.



(From 許榮宗)

Trend of LEDs (efficiency & cost)



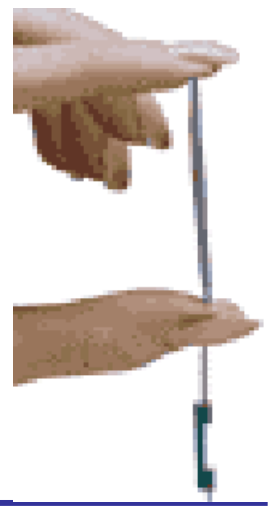
註: 以商業上之紅光LED產品爲計算基準, 數據由H.P. 公司之R Haitz提供.

(From 許榮宗)

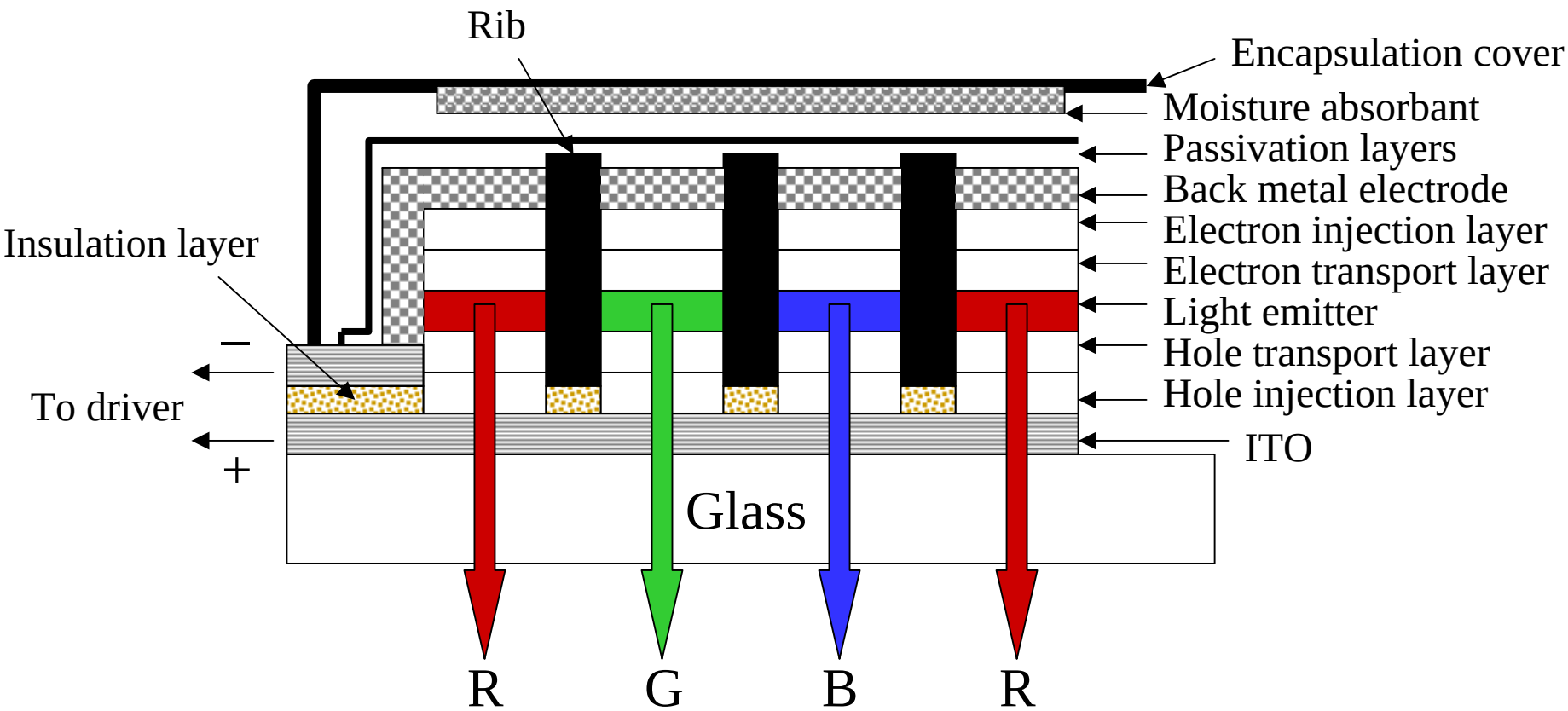
82” LED Backlight

Characteristics of OLEDs

- Self-iluminous, thin & lightweight (No backlight needed)
- Low operation voltage (5~15V)
- High brightness (100,000 cd/m^2)
- No view angle dependence (> 165^o)
- low temp. process, versatile in substrates
- Mechanical flexiblity
- Fast response time(40 ns ~ 10μs)
- Full color (blue, green, red, white, No CF needed)
- Easy fabrication (vacuum evaporation, coating)
  - potentially low cost
- High contrast (200:1)



Structure of OLED



(From 陳良吉)

OLED & PLED

Samsung 2.2” OLED Panel(2002)

Resolution：170×220(QCIF)

pixel pitch：66×198(128ppi)

Brightness：＞200 cd/m2

＃ of color：262144

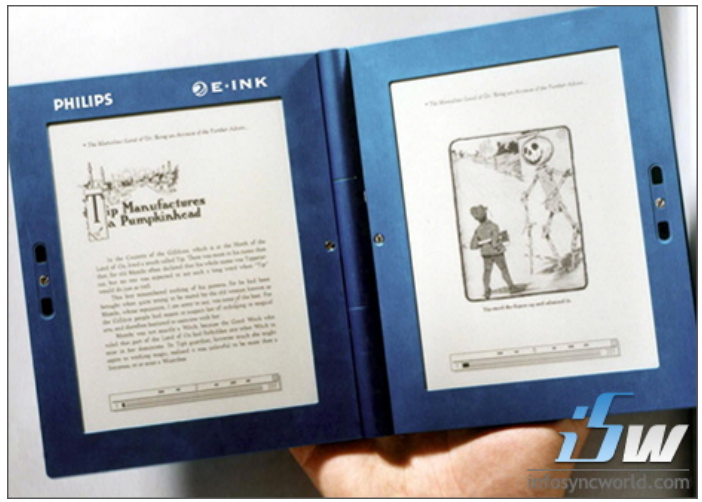
aperture ratio：32%

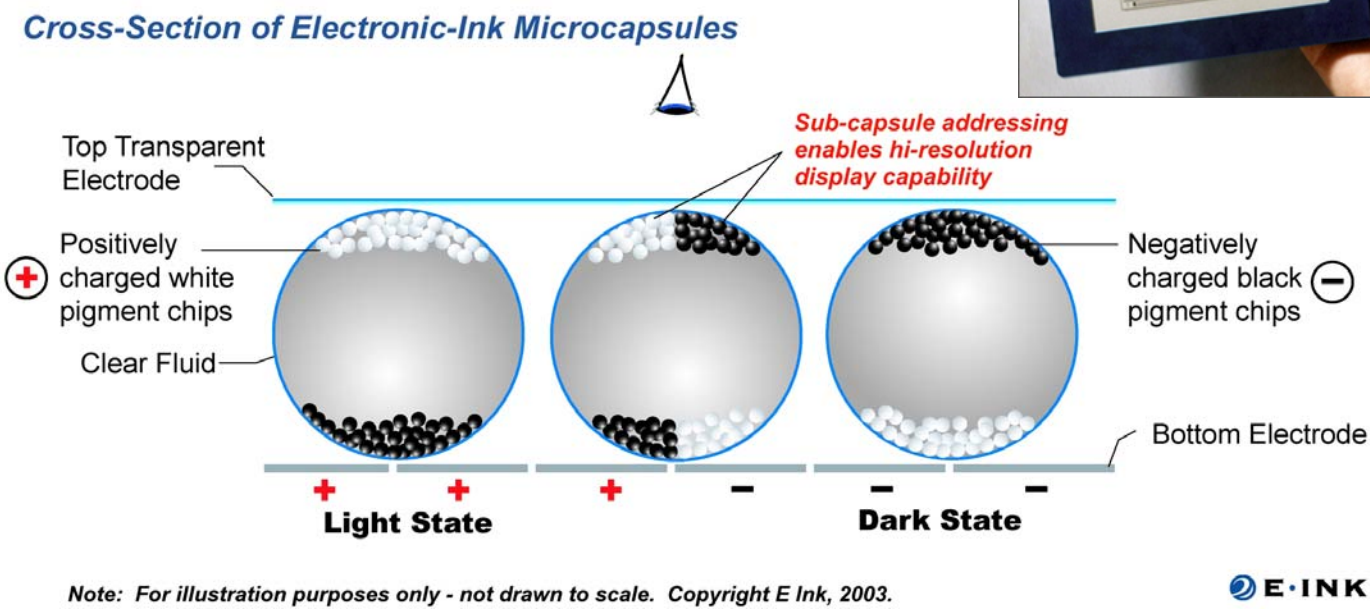
Toshiba 17” PLED

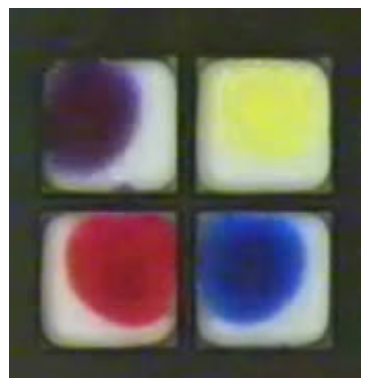
(From 陳良吉)

Paper-like display

Combination of the convenience, robustness and readability of printed material with the vast and flexible information content of laptop computers







(Hayes & Feenstra)

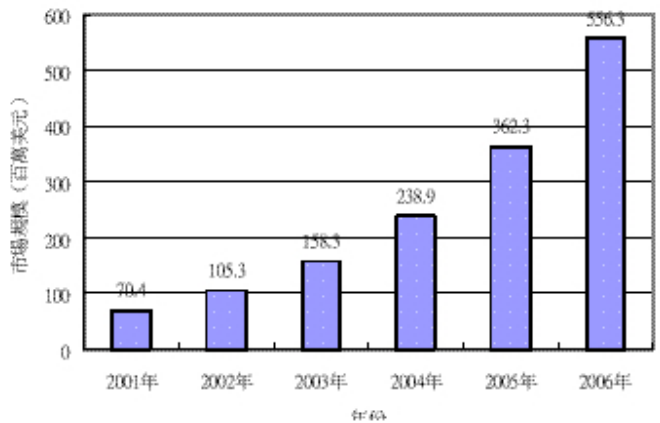
E-Paper

200PPI, 2”, 320x240 @2005 SID

可撓曲的顯示器(Flexible Display)

(Interaction Design Institute Ivrea)

(EuroNanoTex)



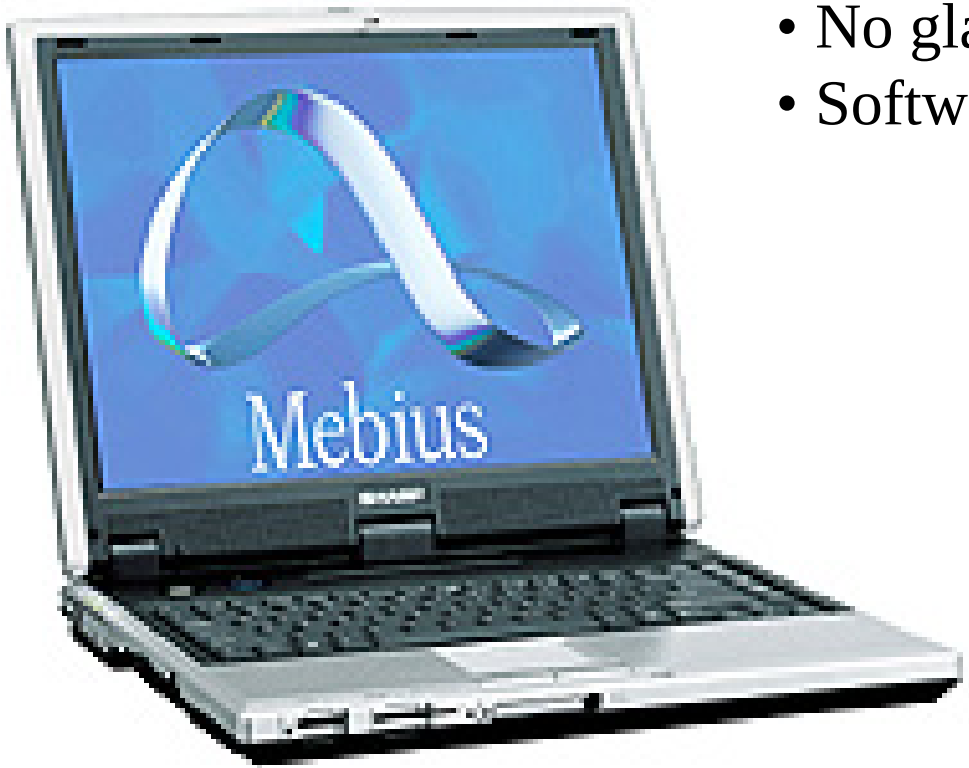
資料來源：Venture Development Corporation 2004

理光发售RFID 可擦写胶片

RECO-View IC-Tag Sheet (第5届自动识别综合展, 2003/9)
Reusable: 500～1000 times
A4-size.

Sharp全球第一款3D LCD-Notebook

- Sharp, Mebius PC-RD3D
- (350000￥ @2003/10)
- No glasses
- Software development



References (I)

- 台灣大學「影像顯示科技種子教師」2003 培訓班 講義，教育部顧問室光機電工程教學資源中心。
- 台灣大學「影像顯示科技種子教師」2004 培訓班 講義，教育部顧問室光機電工程資源中心。
- 台灣大學「平面顯示技術概論」 2003課程講義，教育部顧問室光機電工程教學資源中心。
- 台灣大學「平面顯示技術概論」 2004課程講義，教育部顧問室光機電工程教學資源中心。
- 「光電平面面板顯示器基本概論」，顧鴻壽等六人合編，高立圖書，2003年。
- 「平面顯示器技術及未來趨勢」，龍璟文化，2002年。
- 「平面顯示器生產設備專題研究」，魏依玲，ITRIEK-0267-S402, 2001年。

References (II)

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