Figure 1-1  Worldwide market trend for electronic display from 1991 to 1999

Figure 1-2  Worldwide flat panel display market share by technology
Figure 1-3  15" XGA LCD display made by Philips.
Figure 1-5
(a) Schematic diagram of the working principle for the full color PDP
(b) 63" XGA Resolution PDP made by Samsung Electronics Co., Ltd.
Figure 1-6  
(a) Schematic diagram of the working principle for VFD.  
(b) Grid on Separator (GOS) VFD made by Futaba Corporation.
Figure 1-7  
(a) Schematic diagram of the working principle of ELD. 
(b) 13.2" SVGA ELD made by Candescent Technologies Corporation
Figure 1-8  

(a) The outdoor LED electron billboard made by 1st Choice LED Display.  
(b) The LED sub-panel made by Powerlight
Figure 1-9  The EL display made by Amtex Electronics Pty. Ltd.
Figure 1-11 (a) Prototype of TOLED when turn on and off [16].
(b) Prototype of FOLED made by Universal Display Corporation.
Figure 2-10  (a) One-dimensional potential barrier and three domains.
(b) Schematic representation of the wave function across the potential barrier.
Figure 3-1 The OLED sample for this experiment.
Figure 3- 3 (a) Average current density versus peak voltage (b) Average luminance versus average current density for different multiplexing number
Figure 3-4 (a) Average luminance versus multiplexing number for different average current density (b) Power efficiency versus average current density for different multiplexing number.
Figure 4-2   The OLED sample for this experiment.
Figure 4-3  
(a) The three tanks for ITO glass substrate cleaning.  
(b) The oven for glass drying.  
(c) UV ozone treatment machine.  
(d) Edward Evaporator.
Figure 4-5  (a) Font view and (b) Side view of the measurement setup for surface emission pattern.  (c) Function generator (TOP) and Lock-in amplifier  (d) Absolute luminance measurement setup.
Figure 4-6  The angular distribution of the surface emission for different Alq thickness samples.
Figure 4-8  The power efficiency which calculated with Lambertian assumption and real angular distribution versus Alq thickness
Figure 4-9 The model of the explanation for the widened angular distribution of the surface emission. Due to the convenience, only 21 beams of the divided light are shown. In real cases, more divided light ray should be involved in the interference. $\gamma_0$ and $\gamma_2$ are the Fresnel amplitude reflection coefficients of the boundary between Alq and Al and that of the boundary between glass and ITO respectively. Similarly, $t_1$, $t_2$ and $t_3$ are the Fresnel amplitude transmission coefficients for those boundary. $d_1$ is the thickness of Alq and $d_2$ is the total thickness of those three layers: ITO, CuPc and TPD. This schematic diagram is not drawn to scale.
Figure 4-12 The simulation result: The angular distribution of the surface emission intensity (normalized) verses the view angles for different thickness of Alq layer: 30nm, 50nm, 80nm and 100nm.
Figure 4-13 Comparison between simulation and experiment angular distribution for different Alq thickness (a) 30nm, 40nm and 50nm (b) 60nm, 80nm and 100nm Alq thickness
Figure 4-14 The experimental and simulated solid angle (correction factor) verse Alq thickness
Figure 4-15 The classical harmonic oscillator model of electric dipole in (a) 2-D and (b) 3-D.
Figure 4-16 Illustrate the 1-D alignment idea.
\[ I(\theta) = \sum_{i=1}^{n} I_o^2 \cdot (1 - \sin^2 \theta \cos^2 \phi_i) \]
\[ = I_o^2 \cdot \sum_{i=1}^{n} (1 - \sin^2 \theta \cos^2 \phi_i) \]
\[ = I_o^2 \cdot (n - \frac{n}{2} \sin^2 \theta) \]
\[ = nI_o^2 \cdot (1 - \frac{1}{2} \sin^2 \theta) \]

Figure 4-17 Illustrate the integration of all radiation intensity as a function of internal view angle \( \theta \)
Figure 4-18 The overall radiation pattern of 2-D aligned electric dipoles view in 3-D space.
$$I(\theta) = I_o^2 \sum_{j=1}^{1} \sum_{l=1}^{l} (1 - \sin^2 (\theta - \gamma_j) \cos^2 \phi_l)$$

$$= I_o^2 \sum_{j=1}^{1} k - \sin^2 (\theta - \gamma_j) \frac{k}{2}$$

$$= I_o^2 (l \cdot k - \frac{l}{2} \cdot \frac{k}{2})$$

$$= \frac{3n}{4} I_o^2$$

Figure 4-19 Illustrate the integration of all radiation intensity as a function of internal view angle $\theta$. 
Figure 4.20 Summary of radiation pattern for different dipole alignment
Figure 4-22 (a)-(f) The angular distribution simulation with different dipole alignment for different Alq thickness. (g) The simulated solid angle verse Alq thickness for different dipole alignment.
Figure 4-23 (a)-(l) The angular distribution simulation for different dipole alignment case, Alq thickness and effective refractive index. (m) and (n) simulated solid angle verse Alq thickness for different dipole alignment.
Figure 4-24 The glass substrate has been tilted with an angle $\theta$ during fabrication in order to test the difference in angular distribution between the tilted axis and un-tilted axis.