計畫編號：05

計畫名稱：微結構促進有機電激發光元件之光學性能研究

計畫主持人：林晃巖

計畫中文摘要：

有機電激發光元件(OLED)有廣視角、低耗電、自發光、可撓性、製造流程短等優點，被視為最具競爭優勢的次世代顯示及照明技術之一。然而，由於玻璃基板、有機材料及 ITO 透明電極所組成之層狀結構造成嚴重之波導效應，使得 OLED 之外部量子效率(external quantum efficiency, EQE)僅有 20 至 30%，其他部分是因全反射的現象，而陷在玻璃基板中，這對資訊顯示及照明應用是嚴重問題。針對此問題的研究，已有數種方法被提出來，其中以表面貼附微結構陣列的方法最佳，不僅可促進元件垂直於發光面的輝度效率，亦可增加元件的功率效率，並且影響元件的色座標隨視角的變化最小。

本研究之目的，即是模擬及製作微結構薄膜，與 OLED 結合，藉由破壞波導效應，導出在玻璃基板中全反射之光子，使得其 EQE 有大幅度之提昇，使其早日應用於背光源或平面照明光源之應用，並藉以降低其使用功率，以節省能源之使用。其具體項目有：

(1) 針對特定的 OLED，設計不同形狀之微結構與其陣列配置，以提昇不同的應用面向的發光性能需求。

(2) 針對具有不同發光特性之 OLED，設計與製作對應之微結構，以提昇整體元件效率。

(3) 探討使用熱整形法製作高填充比微結構陣列(因為高效率要求)，而後結合模仁製作、紫外線成形技術翻製塑膠膜片。

計畫英文摘要：

Organic light emitting devices (OLEDs) is one of the promising display and lighting technologies due to the advantages of high brightness, high contrast, large view angle, and potentially low cost. In such a device, photons are generated in the organic thin films. When they radiate from the high-refractive-index-medium, such as organic layers and glass substrate, to the air, part of the light is trapped inside the OLED due to the total internal reflection. Typically, the extraction efficiency is lower 30%, which means more than 70% of light is guided inside the glass substrate and organic thin films. In other words, it is possible to increase the external quantum efficiency by three times provided that all the generated photons radiate out of the OLED. In our group, we have demonstrated a 50%-enhancement in extraction efficiency by attaching a microlens array film on the glass substrate of a conventional bottom-emission OLED. Hence, micro-structures have been proven to effectively destroy the waveguiding effects in the organic thin-films and glass substrate.

The objective of this project is to quantitatively investigate the

improvement of optical characteristics of the OLED with micro-structured attachment. We will systematically simulate, fabricate and study the effects of micro-structure with different sizes, geometries, and layouts to the OLED on glass substrates. We will propose some structures for improving the electrical and optical characteristics of OLED simultaneously. Besides, OLED with different organic materials and layer structures will also be discussed. We will also study the fabrication and replication process for micro-structure with high-fill-factor. We will make prototype of OLED with micro-structured attachment to get high efficiency and high contrast ratio.