計畫編號：06

計畫名稱：具實用性之光子晶體發光二極體製作技術

計畫主持人：楊志忠

計畫中文摘要：

本計畫中，我們將利用光學干涉技術配合光輔助電化學蝕刻方法，在不使用電子束微影及乾式蝕刻等昂貴技術情況下，直接在氮化銦鎵發光二極體上製作奈米等級之一維或二維光柵或光子晶體結構，以增加發光二極體的汲光效率並調整發光二極體的輻射場型。首先，我們先將利用雷射直接干涉來產生週期可調變之條紋，配合光輔助電化學蝕刻技術，製作光子晶體結構，量測其特性，並瞭解其物理機制，依此結果設計最優化相位光罩條件。我們將訂製適當週期的相位光罩，以建立於發光二極體上製作一維或二維光柵或光子晶體結構可量產、低成本之技術，量測其結果，並最優化蝕刻深度及其他參數。最後，我們希望建立光子晶體發光二極體量產技術流程。

計畫英文摘要：

In this project, we propose to combine the optical interference technique and the photoelectrochemical wet etching method to directly fabricate nanometer-scale one-dimension or two-dimension grating or photonic crystal structures on InGaN-based light-emitting diodes for increasing their light extraction efficiencies and modify their radiation patterns. Without using the expensive electron-beam lithography and dry etching techniques, the proposed approach has the advantages of much lower cost and feasible mass production. We will first use the laser interferometry of tunable interference period to fabricate photonic crystal light-emitting diode for understanding the photonic crystal effects and optimize the grating period. The light extraction efficiency, device electrical property, radiation pattern, etc. will be characterized. Also, the fundamental mechanisms behind will be explored. Based on these results, we will design and order a customized phase mask for implementing optical interference for building a mass production technique and optimize the etching depth and other parameters. Finally, we will try to build the mass production technical procedure of photonic crystal light-emitting diode.