設計與製作高效率平面型偏極光分光器以應用於整合型導光板之偏光轉換器

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摘要

在液晶顯示器(LCDs)的發展中，低發光效率一直是一個嚴重的技術瓶頸，其通常會導致液晶顯示器之低顯示亮度與高耗電量。造成液晶顯示器發光效率損耗有以下三個主要因素：色濾光片(color filter)之光損耗、偏極片(polarizer)之光損耗與背光模組之光損耗。為了增加液晶顯示器光的使用率，我們提出一種具有偏光轉換功能之整合型導光板。

本論文的主要貢獻在於設計與製作應用於此具有偏光轉換功能之整合型導光板的高效率平面型偏極光分光器(PBS)。我們利用有效介質理論(EMT)與嚴格耦合波分析(RCWA)理論，並控制不同的幾何參數來設計具有高分光效率的次波長光柵。模擬結果中顯示，具有週期、duty cycle 與深寬比分別為 0.2 μm 、50% 與 3 之次波長光柵，在可見光範圍內可提供 80%之 P 光穿透效率與 97%之 S 光反射效率。而實驗中，我們利用電子束微影(EBL)技術來製作所設計的次波長光柵。將所製作出的次波長光柵進行光效率之量測，並與模擬結果比較，則可得到一個合理的量測結果。

Design and Fabrication of High Efficient Planer Polarizing Beam Splitter for Integrated Lightguide Polarization Converter

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Abstract

Low light efficiency is one significant technical barrier in the development of liquid crystal displays (LCDs), which usually causes low display brightness and high power consumption. Three factors that reduce LCDs light efficiency are：color filter loss, polarizer loss, and backlight unit loss. Thus, an integrated lightquide equipped with polarization conversion is proposed to increase light utilization.

The main contribution of this thesis is to design and fabricate a high efficient planer polarizing beam splitter (PBS) which is applied in the integrated lightquide equipped with polarization conversion. The sub-wavelength grating is designed by using effective medium theory (EMT) and rigorous coupled wave analysis (RCWA). Controlling the geometric parameters of the sub-wavelength grating allows for engineering the efficiency of light separation. The simulated results show that the sub-wavelength grating, which consists of double layers and is of period, duty cycle,

and aspect ratio of 0.2 μm, 50%, and 3, respectively, provides 80% of P-ray transmission efficiency and 97% of S-ray reflection efficiency in the visible spectrum range. In experiments, the designed sub-wavelength grating is fabricated by using electron beam lithography (EBL) technology. The measurements of the fabricated grating are compared with simulated results and found to be in reasonable agreement.