URN etd-0407109-183722-1853
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Statistics This thesis had been viewed 48 times. Download 0 times.
Department
Year 2006
Semester 1
Degree Master
Type of Document Master's Thesis
Language zh-TW.Big5 Chinese
Title Optimization of Longitudinal Microstructure Design in the Incidence Plane of a Light Guide Plate for LED Backlight Units
Date of Defense 0000-00-00
Page Count 67
Keyword
Light guide plate
V-cut longitudinal microstructure
U-cut longitudinal microstructure
Full factorial experiment
Taguchi method
Optimization

Abstract
The light sources of edge-type LED backlight units (BLUs) in small/medium displays are an array of LEDs located inside a lamp reflector and near the incidence plane of a light guide plate (LGP). This kind of structure exists an inherent problem: luminance non-uniformity appearing in the region close to the LEDs, that is, bright zones are formed in the area directly facing the LEDs and between are dark zones in a LGP. Longitudinal V-groove microstructures in the incidence plane of a LGP are a common practice to eliminate this type of defect in the backlight industry. Research focus is on how the placement, orientation, and shapes of microstructures influence luminance uniformity. In this work both longitudinal V-cut and U-cut microstructures will be studied. The focus is on the comparison of performance in luminance uniformity between longitudinal V-cut and U-cut microstructures by using both full factorial experiment method and Taguchi method.
Firstly, full factorial experiment method is implemented to achieve an optimization of longitudinal microstructure design in the incidence plane of a LGP for LED BLUs. There are three control factors involving in the optimization process: the pitch and depth of both V-cut and U-cut, and angle and radius for V-cut and U-cut, respectively. Each individual control factor has three levels. It leads to a total of 27 sets of experiments. Due to the fact that all the possible combinations has been fully considered in full factorial experiment method. An optimal design can be achieved and its conditions can be determined without resorting to factor response analysis. Because full factorial experiment method is time-consuming, it lacks of efficiency. A more effective method, Taguchi method, which has been widely used in the industry, is implemented for the optimization design of a microstructure in this work.
To determine the quality characteristics is the first step in Taguchi method. Since the purpose of this work is to discuss the influence of microstructures in the incidence plane on the luminance uniformity near the incidence plane of a LGP in a LED BLU. The luminance uniformity in the region near the incidence plane is assigned as quality characteristics in Taguchi method. The nominal-the-best is chosen as the ideal function of quality characteristics. Three control factors, involving in the optimization process: the pitch and depth of both V-cut and U-cut, and angle and radius for V-cut and U-cut, respectively, are the same as full factorial experiment method. Each individual control factor is assigned to have three levels too. L9 orthogonal table are applied to examine the tendency

of levels regarding three control factors. The Taguchi's optimal parameter setting is determined through the verification of optical simulations.
By both Taguchi method and full factorial experiment method, we confirm that the longitudinal microstructures in the incidence plane can redistribute the incident light and improve the luminance uniformity of an edge-type LED backlight. In terms of luminance performance of BLUs, there shows no much difference between V-cut and U-cut microstructures from simulation results. However, U-cut microstructure outperforms V-cut one in luminance uniformity.
Advisory Committee Jeng-Feng Lin - advisor

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Files No Any Full Text File.
Date of Submission 2007-01-31