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Abstract
As a light source in a backlight unit (BLU), the requirement for optical characteristics of a LED is different from highly directional conventional ones. New diffused-type LEDs have to be developed to fulfill the need of the BLU industry. The goal of this study is to build optical models for diffused-type LEDs by investigating the diffusing effects of LED LENS, such as surface roughness, volume scattering, etc.

The focus of this study is to develop an accurate optical model for LEDs as a solid basis for future research and development in LED LENS design. In this work, both the die structure and package structure of high-brightness LED are analyzed. Their optical property of applied materials is also investigated to develop a LED optical model. An equivalent LED optical model is created in ASAP programming. Simulations based on Monte Carlo ray tracing are performed to study the radiation patterns of both LED die and LED. Comparison between measured data and simulation results is carried out to validate the accuracy of the developed optical model.

There exist three approaches, surface roughening of, scattering of, and change of geometrical shapes of LED LENS, in diffused-type point-source LEDs design. Each approach is investigated by optical simulations and experiments. We conclude that the effect of surface roughening of LED LENS is not significant in terms of spatial light spreading. However, the goal of diffused-type LEDs still can be achieved by incorporating scattering effect. As a BLU LED, its radiation pattern outperforms the one whose geometrical shapes are changed alone.

Compared to point-source LEDs, LED light rods with diffusing mechanisms show advantages of cost-down and luminance uniformity. The surface roughening effect of a LED rod is investigated. They show great potential replacing the exiting CCFL.
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