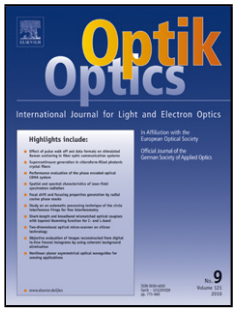

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Fabrication and Optical Properties of Laser Diodes Based on Composite Phosphors Film Packaging

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Abstract: In this paper, we show that white light generation is possible using blue laser diode in combination with phosphor film. The phosphor film was prepared by mixing the green phosphor powder $Y_3Al_5O_{12}$: Ce^{3+} and the red phosphor powder $CaAlSiN_3$: Eu^{2+} with organic resin or silicone, and the phosphor film was pasted on the cap of laser diode, which encapsulates in conventional package for laser diode light-emitting device. The electroluminescence spectra, light distribution and correlated color temperature distribution of the laser diode light-emitting device were investigated. From the electroluminescence spectra, it can be found that the correlated color temperature of 5233 K can be reached, with color rendering index of 72.4. The luminous flux of the device is measured to be 56.37 lm with luminous efficacy of 223.71 lm/w. Through the analysis of near-field optics, it can be seen that although the lighting angle of laser diode light-emitting device is smaller than that of light-emitting diode light-emitting device, its correlated color temperature distribution and brightness distribution are better than that of light-emitting diode. So, it can be generalized that the laser diode light-emitting device has a great prospect in the field of lighting.

Keywords: laser diode, phosphor film, light-emitting diode, optical properties

1 Introduction

At present, the white light used in solid state lighting is mainly white light-emitting diode (LED). The main trend of its illumination is to use blue light chips and different phosphors to achieve white light output. However, under the influence of the droop phenomenon, the luminous flux of a single white LED device is limited, which makes it difficult to reduce the cost. The laser beam is approximately perpendicular to the light surface with high efficiency, high photoelectric conversion efficiency and large optical power output [3-4]. The advantages of laser compared with natural light are the same frequency, phase and polarization direction [5]. Because of its excellent physical properties, laser is widely used in military [6], 3D printing [7], laser cutting [8], health and beauty [9], projection display [10].

The development of laser diode (LD) technology has become mature, but in the field of lighting, the infrared laser is mainly used in infrared imaging and detection, and the using for lighting in the visible band is less. At present, The WPE (wall plug efficiency) of the semiconductor laser in the visible band is more than 70% [11]. Such a high energy conversion efficiency is more energy efficient than traditional incandescent and phosphor lamps. In addition, the laser chip and the phosphor layer are at a certain distance, the light-emitting process is very easy to solve the heat problem, which is different from traditional LED package. At present, most