Imaging characteristics of gradient-index array containing tilted element

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1. Introduction

An LED printer is an electro-photographic printer using LED print head (LPH). The LPH consists of LED array and Gradient-Index (GRIN) array [1]. Figure 1 (a) shows a configuration of LED printer. The GRIN array projects an erected unit magnification image of the LED array on the photoconductor. Figure 1 (b) illustrates the LPH. The GRINs are arranged at larger interval than that of LEDs. The GRIN has a field view larger than its arrangement interval. The images by the GRINs are superposed on the image of one LED as shown in Fig. 2.

Differences of image distance between images by each GRIN in an array were investigated when the object distance was shifted [2]. Coupling power losses of a tilted GRIN were analyzed [3]. We examine how the image is degraded by a tilted GRIN in the GRIN array, since an image by a tilted GRIN is not superposed on the image by accurately arranged GRINs.

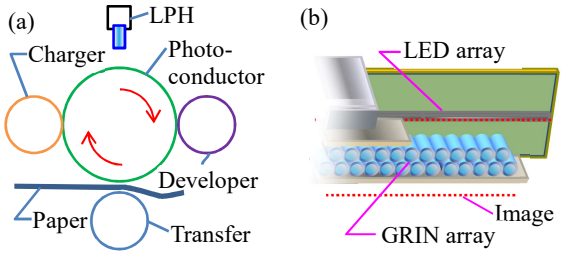

Fig. 1 (a) Configuration of LED printer. (b) Magnified view of LPH.

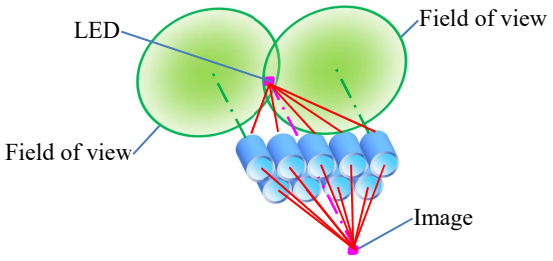

Fig. 2 Field of view of GRINs.

2. Imaging by a GRIN array with a tilted GRIN

A ray matrix is used to trace rays through the tilted GRIN and the accurately arranged GRINs. Illuminance distributions of image by the GRIN array which holds the single tilted GRIN are calculated.

Figure 3 (a) shows a calculation model. The calculation model has nine GRINs including the single tilted GRIN. The GRINs are arranged along the x-axis. The illuminance distribution is calculated along t direction, which is 45° relative to both the x-axis and y-axis. GRIN tilt Δd is defined as a distance between the intersection of the axis of the tilted GRIN and z-axis on the object plane as shown in Fig. 3. Here Δd takes the same value both x and y directions. It is assumed that a point source has a Gaussian irradiance distribution and the full width at the half maximum (FWHM) of the source irradiance is 10μm, which is the same size as the emitting portion of the LED.

The peak value drops more sensibly than that without the GRIN tilt. The GRIN tilts more, the peak value decreases and the illuminance distribution broadens. The illuminance distribution becomes not to superpose on the one image when the value of tilt is equal to or more than 5μm, a half size of FWHM of the source irradiance.

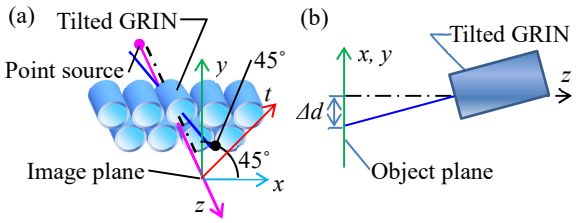

Fig. 3 (a) Configuration of calculation model. (b) Definition of GRIN tilt Δd.

3. Conclusions

When the single GRIN is tilted no more than several tens of percent of FWHM of the source irradiance, the peak value just drops considerably. The illuminance distribution becomes broadened according to the increase of the GRIN tilt. The illuminance distribution becomes not to superpose on the one image when the GRIN tilt is equal to or more than a half size of FWHM of the source irradiance.

Acknowledgements

The authors would like to acknowledge the continuing guidance of Dr. Naoshi Baba, professor emeritus at Hokkaido University.

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