Supporting Information for

Using nanoimprint lithography to improve the light extraction efficiency and color rendering of dichromatic white light-emitting diodes

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1. Additional discussion on the light extraction efficiency for blue light

Fig. S1 displays the contour diagrams of the light extraction efficiency enhancement at a wavelength of 455 nm (blue light) for the nanorods, inverted rods, pyramids, and inverted pyramids having periods ranging from 200 to 900 nm and depths ranging from 200 to 1500 nm. As for the optimization of the light extraction of yellow light, again the light extraction efficiency enhancement for blue light also strongly depended on the structural parameters. The structures providing greater enhancements mostly had periods located in the region from approximately 300 to 400 nm, especially for the pyramid and inverted pyramid structures. We observed that the optimized period for these periodic structures for blue light was smaller than that for yellow light, presumably because of the shorter wavelength of the incident light (the light extraction depended strongly on the effect of diffraction of light). In addition, the enhancements in the light extraction efficiencies of the inverted pyramid structures were also the highest among all of our four kinds of periodic structures. Table S1 lists the highest extraction efficiency enhancements of blue light for the nanorod, inverted rod, pyramid, and inverted pyramid structures, relative to that of a system featuring a flat PDMS layer. Table S1 also lists the extraction efficiency enhancements of these structures under yellow light. The RCWA simulation data suggested that the optimized light extraction efficiency for blue light could be achieved by establishing an inverted pyramid structure having a period of 400 nm and a depth of 700 nm at the PDMS–air interface, providing an enhancement of 25% for blue light and 19% for yellow light.

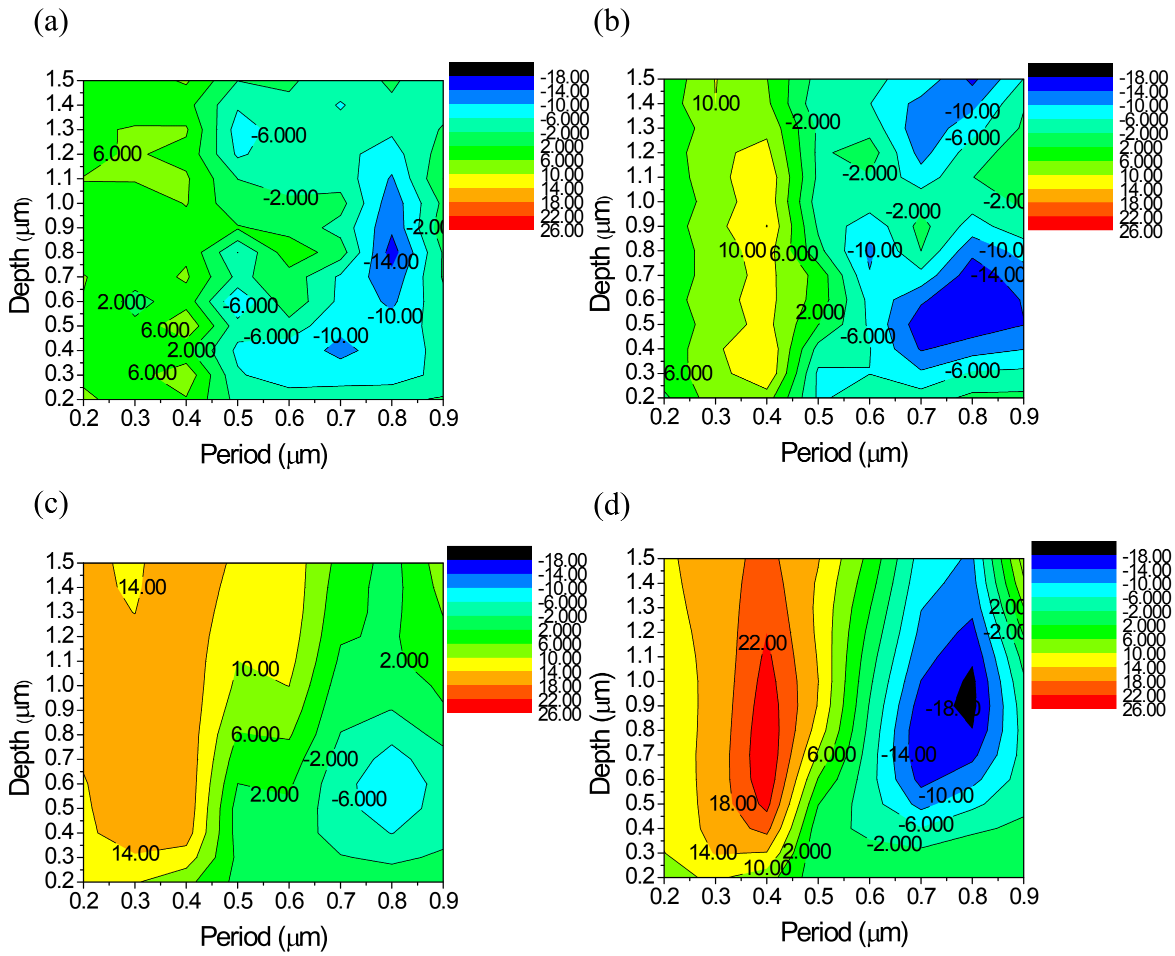

Fig. S1 Contour diagrams of the simulated light extraction efficiency enhancements at a wavelength of 455 nm for (a) nanorods, (b) inverted rods, (c) pyramids, and (d) inverted pyramids having periods ranging from 200 to 900 nm and depths ranging from 200 to 1500 nm.

Table S1. Structural parameters of some textured structures optimized for blue light; the enhancement in light extraction efficiency of yellow light is also listed.

Structure	Blue light (455 nm)	Yellow light (550 nm)
nanorod period 400 nm depth 500 nm	9.38%	8.14%
inverted rod period 400 nm depth 900 nm	14.08%	15.08%
pyramid period 400 nm depth 600 nm	19.62%	19.05%
inverted pyramid period 400 nm depth 700 nm	**25.46%**	**19.21%**

2. The verification of the enhancement in light extraction efficiency for blue light from the textured encapsulation layer

Fig.S2 displays the emitted spectra from the LED without packaging the phosphor before and after adding the inverted pyramid structure on the surface of the PDMS encapsulation layer. After incorporating the textured encapsulation layer on a GaN-based blue LED, the intensity of the blue light at 455 nm could be effectively enhanced by approximately 16%.

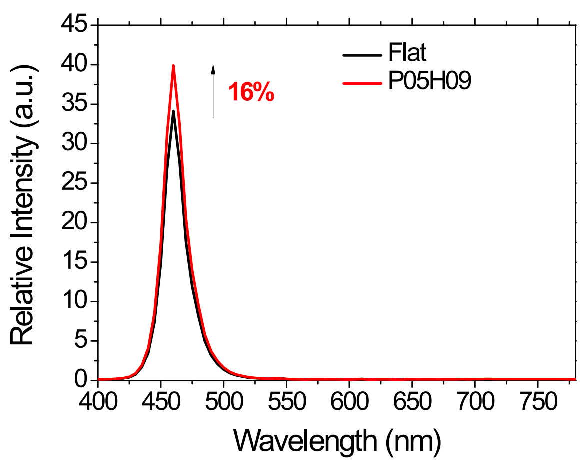

Fig. S2 Emitted spectra from the LED without packaging phosphor in the absence and presence of the inverted pyramid structure on the surface of the PDMS encapsulation layer.