

**Direct printing process based on nanoimprint lithography to enhance the light extraction efficiency of AlGaInP based red LEDs**

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**Abstract**

In this study, we fabricated the high-brightness AlGaInP-based red light emitting diodes (LED)s using by direct printing technique and inductive coupled plasma (ICP) reactive ion etching (RIE). In general, surface roughening was fabricated by wet etching process to improve the light extraction efficiency of AlGaInP-based red LED. However, a structure of the surface roughening, which was fabricated by wet etching, was tiled cone-shape after wet etching process due to crystal structure of AlGaInP materials, which was used as top-layer of red LED. This tilted cone-shape of surface roughening can improve the light extraction of LED, but it caused a loss of the light extraction efficiency of LED. So, in this study, we fabricated perfectly cone shaped pattern using direct printing and dry etching process to maximize the light extraction efficiency of LED.

Both submicron pattern and micron pattern was formed on the surface of red LED to compare the enhancement effect of light extraction efficiency of LEDs according to the diameter of sapphire patterns. After patterning process using direct printing and ICP-RIE proceeded on the red LED, light output was enhanced up to 10 % than that of red LED with wet etched structure. This enhancement of light extraction of red LED was maintained after packaging process. And as a result of analyze of current-voltage characteristic, there is no electrical degradation of LED.

**Keywords:** AlGaInP based-Light emitting diodes, light extraction efficiency, direct printing