Selective area regrowth for dual-color-emitting LEDs by MOCVD

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Due to superior optical properties including a wide range bandgap engineering, III-Nitrides have become representative materials for light-emitting diodes (LEDs). InGaN-based LEDs can cover a wide range in visible spectrum by varying the Indium (In) composition. For this reason, InGaN-based LEDs have an advantage for full-color light sources. In addition, there are many other advantages as an inorganic compound material, including high carrier mobility, long-term stability and reliability. For mobile (or flexible) displays, the important factor is an integration of high-resolution and size-minimization in full-color light sources. However, the conventional inorganic LEDs emit only a single color and can be designed by horizontal arrays for full-color light sources. Several studies were reported for high-integration in a multiple quantum wells (MQWs) with dual wavelengths form using Si and Zn co-doped active layers[1], carbon implantation[2], and insertion layer[3]. However, it emits dual-color lights simultaneously and is hard of control each color independently. Therefore, we demonstrated dual-color-emitting LEDs that can control each color emission at same position from an n-p-n LED structure with two MQWs having different wavelengths (blue and green) by selective area growth (SAG) using metalorganic chemical vapor deposition (MOCVD)[4].

In this study, we grew a blue LED structure on a green LED epi-structure with a GaN buffer layer by MOCVD. First, we prepared a conventional green LED with 300 nm of the *p*-GaN layer grown by MOCVD with a SiO_2 mask. The SiO_2 mask is for fabrication of a common p contact which enables respective operation of two color emission. Subsequently, we grew a GaN buffer layer on the green LED epi-structure, followed by a low-temperature-grown blue LED. The existence of the GaN buffer layer was found to be a key factor for dual peak emission of the monolithic LED. Finally, we demonstrated the dual-color-emitting LED through the fabrication including 3 terminal contact formation. We conducted a study on the GaN buffer layer with various dopings, temperatures, and thicknesses. Then, the optical properties of the dual-color-emitting LED were observed by photoluminescence (PL) and electroluminescence (EL). As a result, the dual-color-emitting LED with 100 nm of the *p*-GaN buffer layer showed clear dual peak emissions as in Figure 1.

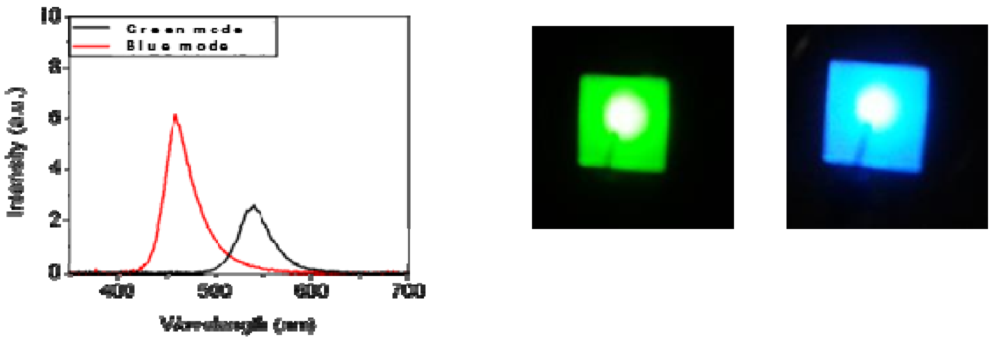

Fig. 1. dual peak emission (green and blue) spectra and optical microscopy images of the dual-color-emitting LED

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