Symposium (Oral) | Symposium | JSAP-KPS Joint Symposium: Wide Bandgap Semiconductor Devices

[19p-CE-1~4]JSAP-KPS Joint Symposium: Wide Bandgap Semiconductor Devices

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Wed. Sep 19, 2018 1:00 PM - 2:45 PM CE (Century Hall)

△ : Presentation by Applicant for JSAP Young Scientists Presentation Award

▲ : English Presentation

▼ : Both of Above

No Mark : None of Above

1:00 PM - 1:30 PM

▲[19p-CE-1]Enhanced Light Extraction from AlGaN Deep-Ultraviolet Light-Emitting Diodes

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Keywords:light-emitting kiodes, deep ultraviolet LED, AlGaN

Despite a rapidly-growing demand for efficient man-made deep-ultraviolet (DUV) light sources, widespread adoption of AlGaN-based DUV LEDs is currently obstructed by extremely poor extraction of DUV photons due to the intrinsic material properties of AlGaN including low hole concentration and poor light extraction efficiency (LEE). Conventional LEE-enhancing techniques used for GaInN-based visible LEDs turned out to be ineffective for DUV LEDs due to a strong absorption of DUV light by p-GaN contact layer, and predominant TM polarized anisotropic emission from Al-rich AlGaN multi-quantum well (MQW) active region grown on c-plane sapphire substrate. Therefore, a new LEE-enhancing approach addressing the unique intrinsic property of AlGaN DUV LEDs is strongly desired.

In this study, we present DUV LEDs having arrays of TC shaped active mesas coated with MgF_2/Al reflectors on the inclined sidewalls to extract strong TM-polarized in-plane emission trough the sapphire substrate. Ray tracing simulations reveal that the TC DUV LEDs show an isotropic emission pattern and much enhanced light-output power in comparison with stripe-type DUV LEDs with the same MgF_2/Al reflectors. Consistent with the ray tracing simulation results, the TC DUV LEDs show an isotropic emission pattern with 37.1% higher light-output power as well as lower operating voltage than the stripe-type DUV LEDs. Based on our results, we suggest strategies to design an optimized DUV LEDs for further enhancing the optical and electrical performances simultaneously. In addition, we propose a next generation DUV LED with an array of Al nanoparticles capable of enhancing IQE and LEE simultaneously by surface plasmon resonance coupling.