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Effect of Dopant Activation on Device Characteristics of InGaN-based Light Emitting Diodes NICHOLAS LACROCE, GUANGYU LIU, CHEE-KEONG TAN, Center for Photonics and Nanoelectronics, Department of Electrical and Computer Engineering, Lehigh University, RONALD A. ARIF, SOO MIN LEE, Veeco Instruments, Inc., NELSON TANSU, Center for Photonics and Nanoelectronics, Department of Electrical and Computer Engineering, Lehigh University
— Achieving high uniformity in growths and device characteristics of InGaN-based light-emitting diodes (LEDs) is important for large scale manufacturing. Dopant activation and maintaining control of variables affecting dopant activation are critical steps in the InGaN-based light emitting diodes (LEDs) fabrication process. In the epitaxy of large scale production LEDs, in-situ post-growth annealing is used for activating the Mg acceptor dopant in the p-AlGaN and p-GaN of the LEDs. However, the annealing temperature varies with respect to position in the reactor chamber, leading to severe uniform dopant activation issue across the devices. Thus, it is important to understand how the temperature gradient and the resulting variance in Mg acceptor activation will alter the device properties. In this work, we examine the effect of varying p-type doping levels in the p-GaN layers and AlGaN electron blocking layer of the GaN LEDs on the optoelectronic properties including the band profile, carrier concentration, current density, output power and quantum efficiency. By understanding the variations and its effect, the identification of the most critical p-type doping layer strategies to address this variation will be clarified.

Nicholas Lacroce
Center for Photonics and Nanoelectronics, Department of Electrical and Computer Engineering, Lehigh University

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