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Multi-section Nanorod Light-emitting Diode

Professor Yang received his BS and Ph.D. degrees, both in electrical engineering, from National Taiwan University and University of Illinois at Urbana-Champaign, in 1976 and 1984, respectively. After nine year service as a faculty member at the Pennsylvania State University, he returned to Taiwan in 1993 and became a faculty member in the Institute of Photonics and Optoelectronics, and Department of Electrical Engineering, National Taiwan University, in which he is currently a distinguished professor. Professor Yang has published about 275 SCI journal papers and made more than 680 presentations at prestigious international conferences, including over 110 invited talks. His research areas include MBE and MOCVD growths of wide-band-gap semiconductor nanostructures, LED fabrication, plasmonics, and bio-photonics. Professor Yang is a fellow of Optical Society of America and a fellow of SPIE. He is also a recipient of the MOST outstanding research award.

In the pulsed growth for GaN nanorod (NR) growth with MOCVD, the Ga and N sources are switched on and off alternatively. When the supply durations of both Ga and N are kept constant, an NR of a uniform cross section can be obtained. However, if we decrease the Ga supply duration while maintaining a constant N supply duration, a tapering section of decreasing cross-sectional size is formed. Based on such a tapering process, multi-section NRs of changing cross-sectional size can be grown. By depositing sidewall InGaN/GaN quantum wells (QWs), we can measure an even broader QW emission spectrum, when compared to a single-section NR, due to the even larger variations of QW thickness and In compositions among different sections of different cross-sectional sizes. Multi-section GaN NRs have a large variety of application, including phosphor-free white-light emission, field emission, and bio-sensing. In this presentation, we first describe the growth process for forming a multi-section GaN NR array. Then, the mechanism for such a growth process is discussed. Next, sidewall QWs and p-GaN are deposited for fabricating a light-emitting diode (LED) array. The emission behaviors of sidewall QWs and the LED performances are demonstrated. Theoretical modeling for understanding sidewall QW emission behaviors is introduced

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212

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