19p-PB6-25

Realization of vertically well-aligned GaN nanowire based core-shell array growth by MOVPE : Morphology evolution and luminescent properties

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In this study, we carried out a scalable process for the precise position, morphology-controlled selective area growth of Ga-polar GaN nanowire arrays by metalorganic vapor phase epitaxy (MOVPE) using a pulsed-mode growth procedure. In order to understand GaN nanowires growth mechanism, we focus on their structural transition according to changing growth parameter such as nucleation dependence (filling process), growth temperature, pulsed-growth cycle, and various V/III ratio. After GaN nanowire growth, we investigate possibility of GaN nanowire arrays as basal template for growth of InGaN/GaN multiple quantum wells (MQWs). Especially, we mainly focus on optical properties of GaN nanoarchitecture coaxial arrays according to extended sidewall non-polar $\{1\bar{1}00\}$ *m*-plane area in this research. Cathodoluminescence (CL) measurements are carried out to investigate the local emission characteristics from the MQWs of GaN coaxial arrays as shown in Fig. 1. The images clearly show the bright sidewall emission on m-plane of GaN nanowire. According to our results, we believe that the GaN nanowire arrays specifically exposed sidewalls non-polar $\{1\bar{1}00\}$ planes with dislocation free structure in GaN nanowire will enable significant advances to reduce the piezoelectric fields and increase the radiative recombination efficiency for general solid-state illumination applications.

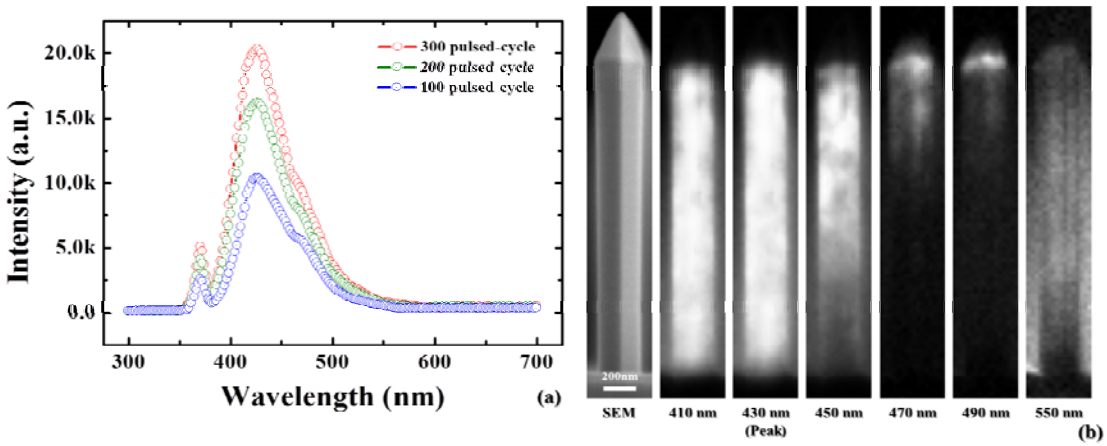

Fig. 1 (a) The CL spectra of GaN nanowire based InGaN/GaN MQWs coaxial arrays according to different active area region depend on exposed m-plane area. (b) The monochromatic CL mapping images at a wavelength of 410, 430, 450, 470, 490, and 550 nm.