表面積制御によるマイクロプレート型多色発光 LED の同時成長

Simultaneous Growth of Multi-Color Micro LEDs Based on Super Thin Micro-Platelets with Various Surface Areas

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The simultaneous growth of core-shell nanorods (NRs) structure with InGaN/GaN Quantum Wells (QWs) for full-color micro-LED application has been achieved through controllably regulating the diameter and pitch of masked cavity in selective area growth (SAG). To our best knowledge, the inhomogeneous distribution of indium content in various exposed crystallographic planes of InGaN/GaN NRs results in undesirable broad emission peak and low color purity of micro-LED chip. In our work, an ultrathin micro-platelet structure equipped with top *c*-plane of large proportion is prepared by MOVPE SAG for improving uniformity of indium content in microstructure, thus contributing to higher color purity of micro-LED. Moreover, a systematic study about the simultaneous growth of the micro-platelet structure with varying dimensions has been carried out for full-color micro LED application.

Super thin micro-platelet structures with varying diameters ranging from 2.5 to 9.0 μm are fabricated (Fig. 1a-c)) with continus MOVPE growth. 60 nm-thick SiO_2 selective mask was deposited on a commercial n-GaN on sapphire template. The circle pattern was then opened by the combination of maskless lithography and plasma etching. Overall 5 periods InGaN/GaN multi-quntam wells (MQWs) was deposited onto the platelet subsequently. The ratio of the dominant top c-plane to the surface area of a single optimized micro-platelets exceeds 90% instead of reported <30%[1)]. A shift of PL peak (excited by a He-Cd laser of 325 nm,15 mW) of the super thin micro-platelet structures with varying diameter of 2.5-9.0 μm is achieved from 408 to 440 nm (Fig. 1d), which can be attributed to thicker QWs and faster growth rate enrolling more indium content. Compared with reported NR-based micro-LED[2)], the ultra-thin micro-platelet structure with single diameter exhibits sharper PL FWHM and greater monochromaticity compared with NRs LED. This work will contribute to the fabrication of multi-color micro-LED chip monolithically integrated by micro-platelet structures with varying dimensions.

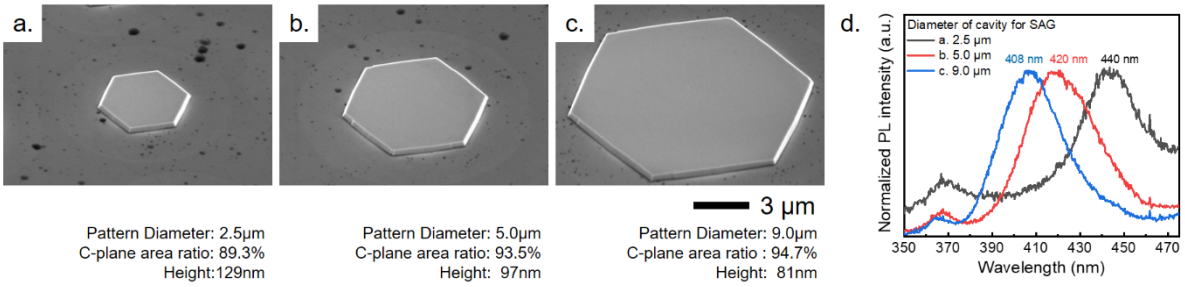

Fig. 1 SEM bird's view images of ultrathin micro-platelet structures (without MQWs) with varying diameter: (a) 2.5 μm, (b) 5.0 μm, and (c) 9.0 μm. (d) micro-PL spectrum of micro-platelet structures with varying diameter of 2.5, 5.0, and 9.0 μm.

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