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Boron (B)- and nitrogen (N)-codoped 6H-SiC epilayer exhibits strong donor to acceptor pair (DAP) band luminescence which makes it a promising candidate for the white light emitting diode (LED) [1]. To investigate the optimized dopant concentrations, five samples with the same B concentration level and varies N concentrations were grown by the fast sublimation growth process (FSGP) and analyzed by the photoluminescence (PL) and angle-resolved PL measurements. Secondary ion mass spectrometry (SIMS) and Raman spectroscopy confirm the increasing N concentration from sample #a to #e [2].

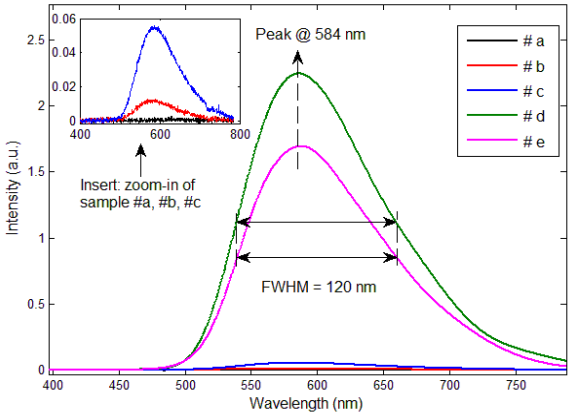

Figure 1. PL spectra of B-N-codoped 6H-SiC sample with emission angle of 0 degree (normal incidence, insert: zoom-in of sample #a, #b, #c).

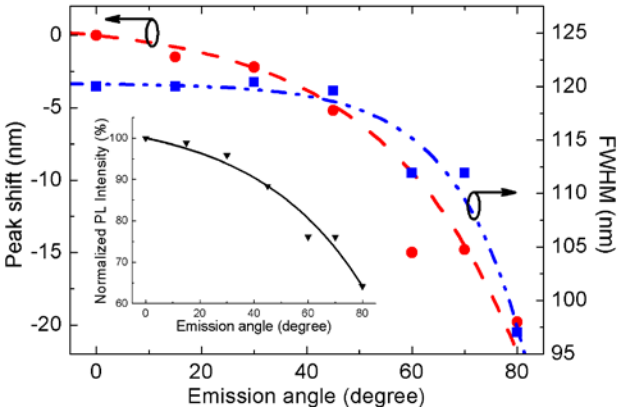

Figure 2. Variation of PL peak shift and FWHM with increasing emission angle in sample #d (Insert: change of normalized PL intensity).

The PL spectra are shown in Fig. 1. It is seen that high-level p-type sample (#a) exhibits extremely low DAP emission efficiency, while low-level p-type samples (#b, #c) have relatively stronger DAP emission but still at a low level. Intense DAP emission was observed in n-type samples (#d, #e) and the strongest DAP emission occurred in sample d with B and N concentration difference of 4.6 x 10^{18} cm^{-3}. Despite the intensity difference, all the DAP emission spectra show the same peak wavelength at 584 nm and with a full width at half maximum (FWHM) of 120 nm. From Fig. 2, it is shown that the peak wavelength blue shifts with increasing emission angle in sample #d, and the FWHM starts to decrese and becomes more dramatic when the emission angle is larger than 45 degrees. Our results revealed that the optimized way to achieve intense DAP emission in B-N-doped 6H-SiC is to use low-level n-type doping with both B and N concentrations exceeding 10^{18} cm^{-3}. Also the their difference should be larger than 4 x 10^{18} cm^{-3}.

References

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2. Y. Ou, et al., submitted to ICSCRM 2011 (2011).