Correlation between Ring Structures and Photoluminescence in InGaN Quantum Well Devices Analyzed by SNOM and AFM

K. Oikawa[1], **Z. Zhang**[2], **Y. Kawakami**[2], **and R. Micheletto**[1]

[1]Yokohama City University, Japan
[2]Kyoto University, Japan

Abstract— InGaN device semiconductors are very important to develop new optical devices useful for a variety of modern applications. In this study, we measured the optical properties and surface topography of InGaN/GaN samples with a emission peak wavelength of 515 nm (green, indium concentration estimated to be about 25%) by scanning near-field optical microscopy (SNOM) and tested its surface topography with atomic force microscopy (AFM). We found noticeable correspondence between the optical properties and surface topography, a fact that was reported in previous literature for blue and red wavelength samples. Our samples were fabricated by metal organic chemical vapor deposition (MOCVD). Their structure consists of a 4 μm GaN layer grown on a sapphire substrate (0001), on which a 3 nm InGaN active layer and a 5 nm GaN cap layer were deposited. SNOM images were obtained for each photoluminescence emission wavelength. In the spectral distribution of the SNOM image, a split peak was observed. We compared the SNOM images corresponding to the split with the AFM image. The positional relationship between the bright areas in the SNOM image and the rings-shaped lines found in the AFM image is noticeable and consistent. Specifically, three emission domains and their corresponding ring-shaped defects were observed. Our result is consistent with previous studies where round-shaped bright spots were associated to round domains in the topographic profile. In our samples the round domains emit light slightly blue-shifted compared to the surroundings. Since, the photoluminescence is blue-shifted this suggests that in those regions there is reduced indium concentration and a better efficiency.