Micro-photoluminescence of InGaN/GaN quantum wells grown on miscut c-plane substrates

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The aim of our work was to determine the role of the miscut c-plane substrates on radiative recombination in InGaN/GaN quantum wells dedicated for UV and violet light emitters such as superluminescent light emitting diodes and laser diodes. The studied samples contained separate regions, angled between 0.16° and 1.6° to the wurzite polar (0001) plane (see Fig.1). These miscut regions were oriented towards the *a* (sample a) and towards the *m* (sample b) wurzite axes, and have been fabricated by special photolithography and ion etching techniques.

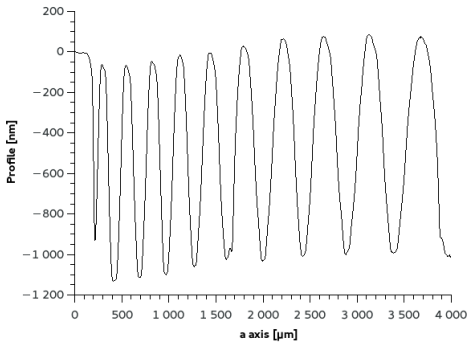

Figure 1: Profile of sample a. Miscut regions oriented to *a* wurzite axis.

Typical micro-photoluminescence spectra for angles 0.93°; 0.8°; 0.58°; 0.44°; 0.16° oriented towards *a* wurzite axis are shown in Fig. 2. We found the correlation between the miscut angle of the substrate (for both orientations: *a* and *m* wurzite axes); the increase of the angle from 0.16 to 1.6 led to increase of PL photon energy from 3.09 to 3.23 eV for sample a and from 3.09 to 3.17 eV for sample b. We explain the photon energy increase as the increase of the alloy bandgap, caused by reduced indium incorporation on more angled surface. We show arguments that this effect is due to lower atomic steps lateral velocity during growth.

Morphology of the surface in these regions was studied using Atomic Force Microscopy. For regions with angles smaller than 1° atomic steps were observed, whereas for bigger angles, large step bunching could be seen. The exact value of miscut was also determined in this measurements. Optical properties and their dependence on the miscut angle were studied using micro-photoluminescence technique. The samples were excited by the third harmonic (300 nm) of Ti:sapphire laser. The diameter of the light beam was about 10 µm.

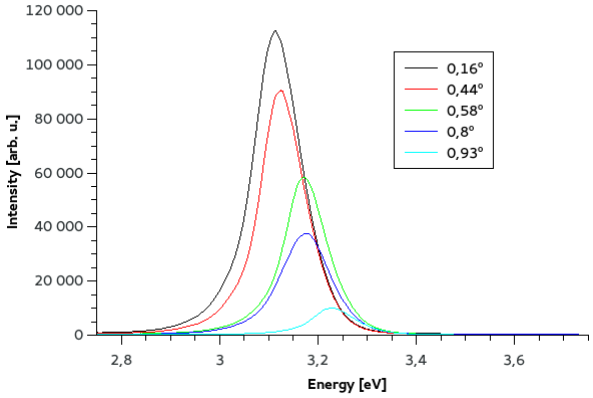

Figure 2: Typical micro-photoluminescence spectra for angles 0.93°; 0.8°; 0.58°; 0.44°; 0.16°.