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*NEBRASKA CENTER FOR MATERIALS AND NANOSCIENCE / NSF-MRSEC SEMINAR SERIES PRESENTS*

MRSEC

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## Submicron beam X-ray diffraction characterization of selectively grown InGaN/GaN-based optoelectronic structures

Modern nanoelectronics is progressing from the planar epitaxial growth-based technology towards monolithic integration of multifunctional structures with complementary optical and electronic properties. Nanoscale selective area growth (NSAG) is a powerful technique for such integration, which holds a promise to improve both the optical properties and structural quality of the grown materials, and GaN-based device compounds in particular. The driving force behind these qualitative improvements is a more efficient bandgap engineering supported by strain relaxation at the sidewalls of the selectively grown nanostructures. A detailed analysis of the fundamental growth mechanisms and how they affect the structural and optical properties of the GaN-based NSAG structures is an important step towards their industrial applications.

The adequate characterization tools, such as synchrotron radiation based submicron-beam high-resolution x-ray diffraction (HRXRD), are required to support the current trends in monolithic materials integration. Here I will present our recent characterization results obtained with a nondestructive HRXRD technique and reciprocal-space-mapping (RSM) analysis with the x-ray beamsize of 240 nm [1]. For example, thickness, strain, composition variation, and details of precursor surface migration have been determined for various NSAG ridge structures with active regions consisted of InGaN/GaN multiple-quantum-wells (MQW) [2].

Our HRXRD experiments have been carried out at two synchrotron facilities: at A2 beamline at CHESS equipped with a one-bounce focusing capillary optics and at the APS 2ID-D microscope beamline equipped with a phase zone plate. In this presentation I will also discuss the requirements for the future generation of the nanofocusing x-ray synchrotron facilities using three important parameters of the beamline setup: the flux as a number of photons seen by the detector (F), the beam-size on the sample (S), and the angular resolution (A), where the figure of merit is the max for the following expression: $F/(S \times A)$.

[1] A. A. Sirenko, A. Kazimirov, A. Ougazzaden, S. O'Malley, D. H. Bilderback, Z.-H. Cai, B. Lai, R. Huang, V. Gupta, M. Chien, S.N.G. Chu, Appl. Phys. Lett., **88**, 081111 (2006).

[2] A. A. Sirenko, A. Kazimirov, S. Cornaby, D. H. Bilderback, B. Neubert, P. Brückner, F. Scholz, V. Shneidman, and A. Ougazzaden, "*Microbeam high-angular resolution x-ray diffraction in InGaN/GaN selective-area-grown ridge structures*", Appl. Phys. Lett. **89**, 181926 (2006).

**Monday, 26 November, 2007**
**105 Othmer**
**3:30 p.m.**

**Host:**
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