Contribution ID: **341** Type: **Poster presentation**

Substrate Surface Orientation Dependent GaN Grown on GaAs by MOVPE

Thursday, May 21, 2015 1:00 PM (3h 30m)

This work presents a comparative study on the effect of substrate surface orientation on the growth of GaN by metalorganic vapor phase epitaxy (MOVPE). GaN films was successfully grown on both the (001)- and (110)-oriented GaAs. With compared to GaN on (001)-oriented GaAs, GaN on (110)-oriented GaAs showed a flat surface and a smooth interface. Root mean square roughness (RMS) measured by atomic force microscopy (AFM) was 61.1 nm and 10.3 nm for the films on (001) and (110)-oriented GaAs, restively. Structural characterization of GaN on (001)-oriented GaAs, which was performed by X-ray diffraction (XRD), exhibited a metastable cubic structure, which slightly contained stacking faults (SF), indicating a generation of hexagonal structure. On the other hand, a mixed structure between cubic and hexagonal structures was observed for the GaN on (001)-oriented GaAs. In order to verify a specific crystal structure, micro-Raman scattering spectroscopy was performed with two different excitation wavelengths of 514 nm and 633 nm. Raman spectra showed phonon modes of cubic-TO at 556 cm^{-1} and hexagonal E_2-high at 569 cm^{-1} for both excitation wavelengths. It was found that phonon mode, corresponding to hexagonal A_1 (TO), was observed at 535 cm^{-1} when the excitation wavelength of 514 nm was used. While, Raman spectra with the excitation wavelength of 633 nm did not show the presence of this phonon mode. Furthermore, when the excitation wavelength was changed from 514 nm to 633 nm, Raman scattering peak at 736 cm^{-1} , which is a signature of hexagonal A_1 (LO), was slightly shifted to the cubic-LO phonon at 740 cm^{-1} . Our results verify that substrate surface orientation a key parameter used to control crystal structure of GaN

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Session Classification: Poster-3

Track Classification: Material Physics, Nanoscale Physics and Nanotechnology