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STRUCTURAL, VIBRATIONAL AND OPTICAL PROPERTIES OF THICK GaPN FILMS GROWN ON GaP SUBSTRATE BY MOVPE

Structural, vibrational and optical properties of thick GaPN films with the N contents of 0.8, 1.8 and 5.4 at% on GaP (001) substrates have been investigated using high resolution X-rays diffraction technique (HRXRD), Raman spectroscopy and micro-photoluminescence spectroscopy (micro-PL). The GaPN films were grown by metalorganic vapor phase epitaxy (MOVPE) using Tertiarybutylphosphine (TBP) and dimethylhydrazine (DMHy) as Ga, P and N precursors, respectively. The thickness of the films with N contents of 0.8, 1.8 and 5.4 at% was reduced to be 347, 327, 317 nm, respectively. All the films were examined under tensile strain with a partial relaxation. Despite the fact that the GaPN films were incorporated with N as high as 5.4 at%, however, smooth surfaces and fairly flat interfaces are visibly observed by atomic force microscopy (AFM) and scanning electron microscopy (SEM). Raman spectra reveal the N-related vibrational modes (N-VMs) in range of 440 – 520 cm^{-1}, which is the first observation for the dilute GaPN alloy. The N-VMs intensity exhibits a linear relationship on the N content determined by HRXRD. This confirms that the incorporated N atoms are substituted at the P lattice, resulting in an isolated local vibrational mode and the NN_i pairs related vibrational modes. Room temperature bandgap was obtained by micro-PL is dramatically reduced when the N content is increased. A huge bandgap bowing parameter of the GaPN is calculated to be 10 eV. The relationship between film relaxation and bandgap reduction is carefully concerned.

Primary author: Mr TOONGYAI, Noppadon (Chulalongkorn University)

Co-authors: Prof. ONABE, Kentaro (The University of Tokyo); Prof. SANORPIM, Sakuntam (Chulalongkorn University)

Presenter: Mr TOONGYAI, Noppadon (Chulalongkorn University)

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