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Effect of Doping Profile and Concentration on the Near-Infrared Optical Properties of AlGaN/GaN and AlInN/GaN Heterostructures MAYRA CERVANTES, COLIN EDMUNDS, DONGHUI LI, LIANG TANG, JIAYI SHAO, GEOFF GARDNER, MICHAEL MANFRA, OANA MALIS, Purdue University — Intersubband (ISB) devices utilizing III-nitrides have recently attracted attention for near- and far- infrared optoelectronic applications. In order to achieve efficient ISB transitions, large doping densities are typically required (>1E18 cm^{-3}). The large impurity density has significant effects on the band structure and material quality, effects that are reflected in important device parameters such as transition energies and linewidths. To determine the optimal doping concentration and profile for III-N intersubband devices, we carried out a systematic study of optical and structural properties of strained AlGaN/GaN and lattice-matched AlInN/GaN heterostructures grown by MBE on quasi-bulk GaN substrates. The lattice-matched AlInN/GaN system is targeted because it allows growth of thick strain-free materials. However, it also presents some considerable growth challenges due to the vastly different optimal growth conditions for Al and In containing nitrides. The transition energy and line profile were determined by direct and photoinduced absorption measurements, while the material quality was assessed using TEM and high resolution x-ray diffraction. The FWHM of the ISB transition at 1.9 μm was found to vary up to 60% with the position of delta doping in the quantum well.

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