Nanocomposites and nanomaterials

Correlated infrared reflectance and Raman analysis of epitaxial n-type doped GaN layers grown on sapphire

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Gallium nitride (GaN) is considered to be a promising material for fabrication of high-frequency, high-temperature and high-power electronic devices. The development of high-quality GaN-based electronic devices requires studying its optical, structural and electronic properties. Infrared (IR) spectroscopy is a simple and nondestructive method for measurement optical and structural properties of semiconductors and in particular of III-nitrides.

The investigated Si-doped GaN layers were grown on MOCVD GaN templates on Al_2O_3 (0001) substrates at a temperature of 800 °C by plasma-assisted molecular-beam epitaxy (PAMBE). The nominal Si doping concentration of the n-GaN layers was $\sim 10^{18}$ cm^{-3}. IR reflectance spectra were measured under incident angle of 13 deg using vacuum FTIR Bruker Vertex 70v spectrometer.

The IR reflectance spectra of GaN-layer/Al_2O_3-substrate system were modelled using the transfer matrix method [1], in which an arbitrary number of layers can be included and interference effects are automatically considered. The complex dielectric function of GaN was described by a single oscillator model [2]. Frequencies of E_1 and A_1 phonon modes, plasmon-phonon modes, and oscillators dumping parameters were obtained from fitting of IR reflectance spectra. Concentration and mobility of charge carriers were estimated from plasma frequency. Obtained results are in good agreement with those obtained by Raman spectroscopy. This work was supported by NATO SfP Grant 984735.

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2. Fenga Z.C., Yangb T.R., Houc Y.T. Infrared reflectance analysis of GaN epitaxial layers grown on sapphire and silicon substrates // Materials Science in Semiconductor Processing.-2001.-**4.**-P. 571-576.