NEAR-INFRARED WAVELENGTH INTERUSBBAND TRANSITIONS IN HEXAGONAL AND CUBIC GaN/AlN SHORT PERIOD SUPERLATTICES

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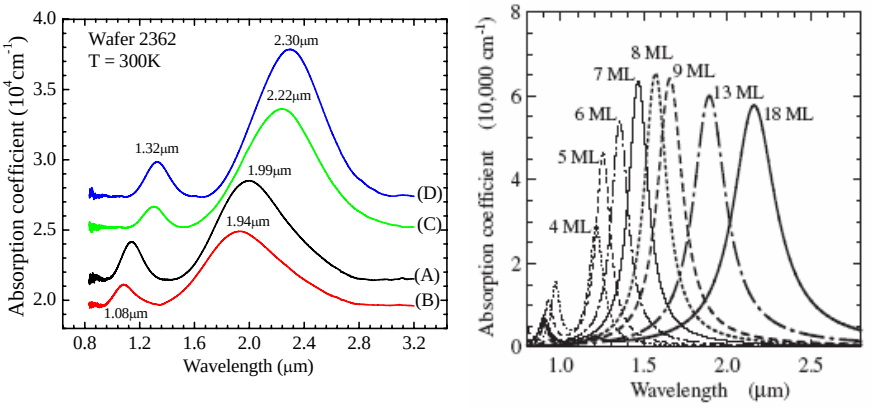
Abstract

Optical absorption and photoconductivity techniques were used to investigate intersubband transitions in GaN/AlN short period superlattices prepared by molecular beam epitaxy. The peak position wavelengths of these transitions are found to span the spectral range of 1.2 – 3.0 μm for samples cut into 45° waveguides with GaN quantum well thicknesses ranging between 1.7 and 2.4 nm. The Fermi energy levels in the GaN wells are estimated from the carrier concentrations, which were measured using an electrochemical capacitance-voltage profiler. Due to the variation of the growth rate across the wafers (as a result of not rotating the sample during growth), an accurate GaN well thickness is difficult to obtain for the parts of the wafer used for these experiments. The well widths were inferred from comparing the measured peak position energy of the intersubband transitions and the bound states energy levels calculated using the transfer matrix method. A few optical absorption spectra are plotted in Fig. 1(a) for samples cut from different locations of a wafer. From the peak position energy of the intersubband transition, it is estimated that the variation in the well thickness is about one bilayer. The spectra show two transitions that are attributed to electronic transitions from the ground state (E_o) to the first excited state (E_1) and from E_o to the second excited state (E_2). These two transitions were predicted by Suzuki *et al*. [1] as shown in Fig. 1 (b). The oscillator strength of the $E_o \rightarrow E_2$ is usually very small, which may not lead to an observable transition in the optical absorption spectrum. However, due to the presence of the built-in electric field in GaN/AlN superlattice, the symmetry of the wave functions of the bound energy levels are broken permitting electrons to make the transition from the ground state to the second excited state.



(a) (b)

Figure 1. (a) *The absorption coefficient spectra of intersubband transitions in GaN/AlN superlattices measured at 300K for four different waveguides cut from the same wafer (this work) and (b) calculated spectra after Suzuki et al. [1].*

REFERENCES:

[1] N. Suzuki, N Iizuka, and K. Kaneko, Jpn. J. Appl. Phys. **42**, 132 (2003).