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Deep Level Transient Spectroscopy Measurements of GaAsBi/GaAs Heterostructures

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Abstract: Bismuth incorporation in GaAs produces a much larger reduction in the band gap than In or Sb alloying, for the same increase in lattice constant. However, Bi is incorporated only at growth temperatures <400?C, making deep level defects a concern. GaAsBi layers, GaAs layers and p-i-n structures containing a GaAsBi quantum well at the center of the i-layer were grown by molecular beam epitaxy in the temperature range 285-580?C. The bismide fraction was 5%. Deep level transient spectroscopy (DLTS) measurements of Schottky diodes fabricated from the GaAsBi and GaAs layers show several different traps, depending on the doping type and growth temperature. Similarly, DLTS spectra from the p-i-n devices vary with the growth conditions and the bismide fraction. Although the DLTS spectra from the p-i-n diodes are difficult to interpret and the spatial location of the traps in these devices is not clear, the trap concentrations were found to be ?5x10^15 cm^-3. Estimated non-radiative recombination rates from the trap parameters obtained from DLTS measurements are consistent with reported photoluminescence and electroluminescence measurements of these GaAsBi p-i-n structures [1], where the luminescence intensity is lower than from other III-V semiconductor structures.

[1] R.B. Lewis, et al. J. Crystal Growth 311, 1872-75 (2009)