

High Field Effects at the P-N Junction for Optical Modulation

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The impedance of the double heterostructure broad area laser diodes with GaAs/GaAlAs were measured using the slotted line at high frequencies in the range 300-500 MHz, with the diode unbiased and reverse biased up to -5 volts. The impedance enabled the depletion layer capacitance of the diodes to be estimated. The theoretical values of depletion capacitance were found to be in good agreement with the experimental values obtained from impedance measurements at zero bias. Theoretical values were calculated using measured doping concentrations.

The experimental values of depletion capacitance deviated from the theoretical values after a voltage of about -1.5 volts in many cases. The estimated depletion layer width at this voltage appears to be nearly 0.3 μ m, which is the usual thickness of the active layer of the DH laser diodes. Thus, the active layer is expected to be fully depleted at this voltage is expected to deviate from the theoretical value. Therefore the technique could be used to estimate the depletion layer thickness of the active layer which is otherwise difficult to be measured.

A strong electric field E of the order of 105 v/cm exists within the active layer when the active layer is fully depleted. The values of E were estimated, for voltages up to -5 volts. According to Franz-Keldysh effect the electric field produces a shift of the conduction band edge, and the estimated shift was found to be approx. 0.15 eV at -5 volts. This electroabsorption effect which is polarization dependent can be used to produce amplitude modulators among other applications. The construction of simple but effective modulators using this means which would have many practical applications in optical communication systems is in progress.