First National Seminar on GaAs and III–V compound semiconductors

Foreword

The electronics revolution started with the discovery of transistor in 1941 and at once underscored the importance of availability at that historic juncture of a suitable material, viz. germanium. Subsequent developments led to the ubiquitous silicon chip and compound semiconductors comprising Groups III and V elements. New devices such as the semiconductor laser, GUNN diodes and IMPATT and new growth technologies like liquid phase epitaxy (LPE) marked a fascinating phase which brought out the interplay of fundamental science, materials processing technology and application. This phase has sustained and is presently illustrated by such discoveries as the Quantum Hall Effect using molecular beam epitaxy (MBE) grown layers, devices like quantum well lasers and high electron mobility transistors (HEMT), metal organic vapour phase epitaxy (MOVPE) and high frequency (microwave and millimeter wave) and optoelectronic devices. The latest commercial application of III–V compounds is in fibre-optics. Operating at 1·3 and 1·55 μ due to minima in fibre loss, these devices are based on InP, a material that is coming into its own, both as a substrate for $Ga_{1-x}In_xAs_{1-y}$ Py sources and $Ga_{1-x}In_xAs$ detectors as well as for TED and IMPATT. Due to superior surface properties MIS devices are currently being realized on the basis of InP. Now that the growth of monolayers is routine, new fundamental research is focussing on the realization of quantum wires and dots in quest of novel phenomenon. Technology is paving the way to strained layer superlattices(SLS) and the growth of mismatched hetero-structures such as GaAs and InP on Si. New practical applications are bound to emerge.

This issue of the Bulletin of Materials Science consists of 18 papers presented at the First National Seminar on "GaAs and III–V Compound Semiconductors" funded by the Department of Electronics and held at IIT, Kharagpur on 29 and 30 April, 1988. It discusses many of the subjects mentioned above commencing with growth of bulk polycrystalline crystals (J N Roy) and liquid phase epitaxy (B M Arora). The growth of lattice-matched $In_{0·57}Ga_{0·43}As$ is described by Dhar and others while Sarin and others present a novel method of reduction of carrier density using rare-earth ions Recently electrodeposition of GaAs has been shown to be possible from aqueous electrolytes (S Moorthy Babu *et al*) although much work requires to be done to achieve device quality. GaSb is another important compound both for substrates and detectors whose growth by vertical Bridgman technique is described by Roy *et al.*

Among newer processing technologies, laser ion beam processing (S B Ogale) is shown to have interesting possibilities while ion implantation (M B Dutta *et al*) is already a well-established technology for MESFET and high frequency devices.

Defect characterization is of crucial importance in evaluating material quality and in comparing and evaluating processing technologies (V Kumar). Electrical techniques such as deep level transient analysis (DLTS) are widely used together with more specialized techniques such as positron annihilation spectroscopy (A Sengupta).

Transport in high mobility ternary layers reveals new physics (B R Nag) besides being important for device applications. Conventional MESFET are the most

widely used devices in MMIC applications (O P Daga *et al*) while IMPATT deliver higher powers well into mm wave region (S K Roy). Digital integrated circuits (D Bhattacharya) are finding a useful niche in the frequency-power spectrum. Two-dimensional transport (P K Basu) has not only generated great interest but also has resulted in new HEMT devices (S Subramanian).

Finally it is shown that as optoelectronic materials, GaAs and InP are still unique as revealed by both heavy doping phenomena (B Seishu and D N Bose) as well as by fibre-optic device applications. It is hoped that the contents based on work being carried out in the country in a technologically existing area will stimulate further research.

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