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Morphological Growth Instabilities on GaAsBi/GaAs(001)

Abstract: Growth of GaAsBi/GaAs is typically restricted to less than 400 °C due to the poor sticking coefficient and incorporation of Bi. At the upper limit of this range, Bi incorporation is relatively low until dislocations allow significant increases in Bi content. These layers, whilst interlaced with defects continue to exhibit room temperature PL. By varying the As:Bi beam equivalent pressure ratio (BEPR) a profile of Bi content can be observed, with marked change in material quality.

Two courses of action are available to reduce defect density, either freezing out defects below 300 °C or reducing the GaAsBi layer thickness to reduce the strain. In the latter method, the strain (Bi content) defines the critical thickness of the active layer prior to dislocation formation. Quasi-bulk layers up to 50nm can be grown at 400 °C with 5.8% Bi content whereas thinner layers can be utilized as quantum wells. Thin layers still exhibit undulations, with the period set by the Bi content. Relatively high Bi content layers exhibit quasi-3D “dash” structures upon relatively thin QW layers, hence a pseudo 3D confinement centers can be constructed. This work presents STM images for bulk, QW and pseudo-3D GaAsBi structures grown at 400 °C.