Invited Talk

Molecular beam epitaxy growth of high quality InAsSbBi on GaSb substrates

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The molecular beam epitaxy growth of the III-V semiconductor alloy InAsSbBi is investigated over a range of growth temperatures and V/In flux ratios. In general, Bi incorporates at growth temperatures around 300 °C, but results in material with limited optical quality. Conversely, higher growth temperatures around 400 °C yield improved optical performance, but with limited Bi incorporation. Both bulk and quantum well structures are grown at temperatures ≥ 400 °C on (100) on-axis and offcut GaSb substrates. The structural, chemical, and optical properties are investigated using Rutherford back scattering, X-ray diffraction, transmission electron microscopy, Nomarski optical microscopy, atomic force microscopy, and photoluminescence spectroscopy. The results indicate that the material is nearly lattice matched, coherently strained, optically active, and contains dilute Bi mole fractions. Large concentrations of Bi-rich surface features are observed on some samples where the incident Bi flux does not fully incorporate or desorb, but instead accumulates on the surface and coalesces into droplet features. Large ~1 μm droplets with densities on the order of 10^6 cm^{-2} are observed when thick InAsSbBi layers are grown with near stoichiometric As flux. Surface droplets are not observed when the As flux is a few percent larger than stoichiometric, indicating that there is an As-Bi interaction that plays a role in the desorption of Bi from the surface. The relationship between the growth conditions and the optical quality, surface morphology, and Bi incorporation is examined.