**Electronic Properties of Bulk Unrelaxed Narrow Gap InAsxSb1-x Alloys**

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**Introduction**

 Having the lowest bandgap among the III-V semiconductors, InAsxSb1-x alloys attract attention for long-wavelength (LWIR) optoelectronics. The alloy band gap depends nonlinearly on the composition as



where C is the bowing parameter [1]. A complication for wide application of this material is that the lattice constant is strongly composition dependent and no binary substrates are available other than for [Sb]=9%, which lattice matches to GaSb. However, the development of a special graded buffer layer which accommodates the large difference between the lattice constant of the substrate and the alloy made it possible to obtain high quality bulk un-strained and un-relaxed InAsxSb1-x [2,3].

**Results and Discussion**

 A series of 1µm thick InAsSb alloys with Sb concentrations x = 0.9 to 0.63 were grown by MBE on GaSb(100) substrates. Compositionally graded 3-4µm thick InGaAlSb buffers were grown to accommodate lattice mismatch between InAsSb and GaSb substrate and AlInSb barriers were grown on both sides on the InAsSb layer. IR transmission spectroscopy measurements were performed in the Faraday configuration at 4.2 K in magnetic fields up to B = 17 T. Using IR magneto-spectroscopy and magneto-transport data we found that in a wide range of compositions the bandgap and the electron effective mass demonstrate negative bowing with the coefficients 0.83 eV and 0.037 eV, respectively. The bandgap values were extracted from the zero field intercept of the main interband transition (**Fig. 1a**). The electron effective mass was extracted from the energy of the cyclotron resonance absorption peak at low magnetic fields (**Fig. 1c**). The alloy with x = 0.63 has the lowest bandgap of Eg = 0.10 eV with an effective mass of 0.008 m0 [5]. To the best of our knowledge, these are the lowest values ever reported for any III-V semiconductor system [4].



**Fig. 1** (a) False color plot of the normalized IR transmission as a function of energy and magnetic field for the sample with Sb x = 0.63. The interband transition appears in red. The dashed line is a fit to the low field data showing the intercept at 100 meV. (b) Bandgap for all samples studied as a function of Sb concentration, x. Diamonds correspond to magneto-absroption data and the red line is the bandgap bowing, eq1, with C = 0.83 eV. (c) Low energy normalized transmission at select magnetic fields showing the cyclotron resonance absorption for the sample with Sb x = 0.63.

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