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High resolution X-ray diffraction and photoluminescence of InAs_{1-x}Sb_x/GaSb

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Abstract content
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InAs_{1-x}Sb_x has the lowest energy band gap among all the III-V semiconductors and has thus received a great deal of attention as an important material to be incorporated into infrared optoelectronic devices. Photodetectors containing this ternary have potential to reach wavelengths up to 9 μm. To achieve this, high quality thin films with few defects and impurities are required. One of the key issues in using InAs_{1-x}Sb_x in the device architecture (particularly for wavelengths greater than 4 μm) is the lack of available lattice-matched substrates. To date, the best performing InAsSb-containing devices are lattice matched to GaSb substrates, with a 9% antimony solid content. (i.e. InAs_{0.91}Sb_{0.09}).

This paper focuses on the deposition of high quality thin films of InAs_{0.91}Sb_{0.09} (between 2 μm and 4 μm thick) on 2″ GaSb substrate. The material deposition is performed in a metal organic chemical vapour deposition (MOCVD) system. The process begins by the deposition of a thin (nanometer thickness range) low temperature buffer layer of either GaSb followed by the deposition of strain free InAsSb. High resolution X-ray diffraction (HRXRD) is used to precisely determine the composition of the ternary alloy as well as to investigate the uniformity across the entire wafer. Photoluminescence (PL), using a Fourier-transform infrared (FTIR) spectrometer, is employed to further explore the material quality and purity. Preliminary measurements indicate consistent thickness and compositional uniformity of the InAsSb layers.

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