Strain analysis of thin III-antimonide layers grown on InAs

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InAs/AlSb multilayers heterostructures are among the most promising structures for the development of quantum cascade laser (QCL) structures emitting in the mid-IR photonic devices. However the understanding of mechanisms occurring during the growth of these structures is not yet fully completed. The lack of atoms in common between InAs and AlSb induces significant structural, electronic and chemical discontinuities at interfaces that have to be controlled to master the properties of the whole structure. The interfacial zones consist of AlAs or InSb bonds that result in important elastic strain levels either in tension or in compression due to the very large misfit between bulk InSb or AlAs with InAs of about +6.6% and -6.6%, respectively. The aim of this work is to study ternary alloys $AlAs_xSb_{1-x}$ instead of pure AlSb barriers in InAs/AlSb multilayers. The use of these alloys with lattice parameters close to that of InAs could reduce or even suppress the epitaxial strain of the device while controlling the nature of interfaces. It would thus allow developing low-stressed mid-IR photonic devices.
The high resolution TEM coupled with geometrical phase analysis was used to determine the strain profile in samples. For each ternary allow, strain levels determined by GPA of the layer are very different than expected suggesting that phase separation or segregation phenomena occurred during growth.

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