Structural characterization of GaSb-based heterostructures grown on Si.

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Monolithic integration of Gallium Antimonide (GaSb) heterostructures on Silicon (Si) is a promising road for producing efficient optoelectronics devices (lasers diodes, integrated photonic circuit...).
One of the problems to overcome for growing such heterostructures on Si is the lattice mismatch between GaSb and Si (12.2%) which generates a high density of dislocations.
To understand and reduce the defects density, we have investigated the structural properties of GaSb grown on Si by Molecular Beam Epitaxy (MBE) using the two complementary techniques X-Ray Diffraction (XRD) and Scanning Transmission Electron Microscopy(TEM/STEM).
We have observed a 2D array of misfit dislocations at the interface GaSb/Si. We have also identified impurities and holes in the substrate that can be a generation source of defects like twins. After optimizing the substrate cleaning process, the twinned volume in the GaSb film was reduced to 75%. The threading dislocations density was also decreased near the interface. Then, We have interested in the evolution of the threading dislocations density with thickness. The aim is to block those defect near the interface. We know that the threading dislocations density decreases slowly with increasing the thickness. Therefore, we introduced super-lattices (like GaSb/AlSb) to create dislocations loops. we are now developing a simulation model using the interaction radius between dislocations to fit the density evolution with thickness (with or without super lattice).