

# **The influence of doping on crystalline quality and surface morphology at GaSb/GaAs nucleation layers**

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Antimony-based compounds cover a wide range of electronic band gaps and have high electron mobility, therefore, are of great interest for electronic and optoelectronic applications in the near- to far-infrared range. Heteroepitaxial growth of Sb-based compounds on GaAs substrates has been extensively studied in recent years, owing to the high quality, high availability and low cost of GaAs substrates compared to GaSb or InAs substrates [1,2].

Due to the large lattice mismatch between Sb-based materials and GaAs substrates (7.8% for GaSb/GaAs, for example), strain and high density of crystalline defects develop at the interface and propagate in the growing layer, limiting the performance of the devices. To obtain high quality material containing low density of crystalline defects it is necessary to optimize the growth conditions at the initial stage of the growth, namely, the nucleation stage [3-5]. It has been found that doping have significant effect on crystalline quality of bulk layers [6], but the origin of the phenomenon is not yet fully understood.

In this work, samples were grown on (001) GaAs substrates by molecular beam epitaxy (MBE). The samples were comprised of 9 MLs GaSb nucleation layers containing different dopants. One sample was grown without dopants, for reference. The growth resulted in islands, owing to the large lattice mismatch. The free surface of the samples was subsequently studied by atomic force microscopy (AFM), electron channeling contrast imaging (ECCI) and high-resolution scanning transmission electron microscopy (HR-STEM). The AFM micrographs were analyzed using a dedicated code developed to robustly recognize the islands and analyze their morphology. The HR-STEM micrographs were analyzed using geometric phase analysis (GPA). The results clearly show that doping affect both crystalline quality and surface morphology at the very early stage of the growth, and different dopants affect these measures differently.

## **References**

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