

LOW DENSITY 3D INAS/GAAS SUBMONOLAYER NANOSTRUCTURES FOR QUANTUM INFORMATION APPLICATIONS

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The high tunability of MBE-grown stacked submonolayer (SML) InAs/GaAs nanostructures has been reported. For quantum information applications such as single-photon sources (SPS), a low density $\sim 10^8 \text{ cm}^{-2}$ of nanostructures is desirable. Such low densities are not easily achieved by conventional Stranski-Krastanov (SK) growth. In this work, SML growth is used to achieve such low densities.

All samples were grown by MBE on s.i. GaAs (001) substrates. On GaAs buffer layers, 10-stack InAs/GaAs SML layers were grown at 500°C. Samples are quenched without growing any cap layer. For the SML growth, <1 ML SML InAs and 2.0 ML GaAs layers were alternately and cyclically deposited. Several samples were prepared, keeping the first 9 InAs SML cycles to 0.4ML, whereas the 10th and final InAs cycle was varied from 0.9 ML to 0.5 ML.

Shown in Fig. 1 are AFM images of SML samples with 0.7, 0.6, and 0.5 ML of InAs in the final deposition cycle. It is observed that by decreasing the amount of InAs in the final cycle, the density of 3D nanostructures is reduced from 10^{10} to 10^7 cm^{-2} . This does not require special conditions, such as post growth annealing or off-cut substrates.

In conclusion, low density of 10^7 cm^{-2} has been demonstrated using SML growth by adjusting the amount of InAs during the final deposition cycle, which is appropriate for SPS applications.

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