# MID-INFRARED PHOTODETECTORS BASED ON GAASSB-CAPPED INAS QUANTUM DOTS

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Quantum dot infrared photodetectors (QDIPs) are very attractive for many applications such as infrared imaging, remote sensing and gas sensing, thanks to its promising features such as high temperature operation, normal incidence response and low dark current [1]. However, the key issue is to obtain a high-quality active region which requires an optimization of the nanostructure. By using GaAsSb capping layer, InAs QDs have improved their optical emission in the range between 1.15 and 1.3 μm (at Sb composition of 14 %), due to a reduction of a compressive strain in QD and an increment of a QD height [2]. In this work, we have demonstrated strong and narrow intraband photoresponses at ~ 5 μm from GaAsSb-capped InAs/GaAs QDIPs under normal light-incidence.

The *n*-*i*-*n* QDIPs were grown on *n*+ Si-doped (001) GaAs substrates using solid-source molecular beam epitaxy. The active region contained 20 periods of 16 monolayer (ML)-GaAsSb capped InAs QDs (2.5 MLs) and separated by 50 nm-thick GaAs barrier layers. The Sb composition in the GaAsSb capping layer was varied from 0 to 17 %. The typical dot density is 4.0 x $10^{10}$ $cm^{-2}$. A δ-doping layer with a carrier concentration of 1.6 x $10^{16}$ $cm^{-2}$ and a thickness of 2.5 nm was located 2 nm below each QD layer. The whole active region was sandwiched between top and bottom *n*-GaAs contact layers doped with Si to $n = 2 \times 10^{18}$ $cm^{-3}$. The QDIPs were processed into mesa of 200 μm in diameter, and a ring-shaped metallization using AuGe/Au was deposited on the top of mesas and alloyed for ohmic contacts. An InSn bottom contact was chosen as the ground for all of the measurements. Photoresponse at 12 K and direct absorption at room temperature were measured by Fourier Transform Infrared spectroscopy (FTIR) using a normal light-incidence.

Photoresponse spectra of the QDIPs with GaAsSb-capping layers show a clear peak at ~5 μm and with its spectral width of $\Delta\lambda/\lambda \sim 0.3$. The integrated intensity and the full width at half maximum (FWHM) of the $GaAs_{0.83}Sb_{0.17}$-capped QDIP are 10 times higher and 30 % lower than reference samples of GaAs-capped QDIP, respectively. The lower FWHM reflects the high-quality QDs and their high homogeneity [2]. The stronger intensity with respect to the GaAs-capped sample is attributed to a reduction of the electron-recapture probability due to a delocalization of the holes from the QD-region that results from the valence band alignment between the QDs, the GaAsSb capping layer, and the GaAs barrier.

## References

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