

Ga-Free InAs/InAsSb Superlattices for Light Detection in the Mid-Infrared Spectral Region

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Interband cascade infrared photodetectors (ICIP) [1] present a novel family of photodetectors capable of photovoltaic operation at and above room temperature (RT) [2]. They employ multiple discrete absorbers with individual thicknesses below the carrier diffusion length separated by unipolar barriers. In first order approximation, the specific detectivity D^* of ICIPs scales with the number of cascade stages N like $D^* \propto \sqrt{N}$ [3] potentially outperforming HgCdTe-based photodetectors [4]. InAs/GaSb superlattice (SL) absorbers are most commonly employed in ICIPs but suffer from low carrier lifetimes due to Shockley-Read-Hall recombination associated with native defects related to GaSb. Substituting GaSb with Ga-free InAs_{1-x}Sb_x SL could potentially circumvent this limitation and further improve ICIP performance.

Different sets of InAs/InAs_{1-x}Sb_x SL were therefore grown on GaSb substrates to investigate growth quality and cut-off wavelength λ_c in the mid infrared (MIR) spectral range. Choosing InAs- and InAsSb-thicknesses according to the Sb-content x [5], allows to grow the SL strain compensated on the GaSb substrate. In a first set of samples, the superlattice period P was varied between 5, 6 and 8 nm while keeping $x=0.35$ constant. Both InAs and InAsSb- thicknesses were varied to ensure strain compensated growth. RT photoluminescence (PL) measurements were performed to investigate the cut-off wavelength. As shown in Fig. 1, λ_c increases with increasing SL period from ~ 7 to 11 μm .

Additionally, the impact of Sb-content on λ_c was investigated by growing an additional series of SL with a fixed $P=8$ nm while varying $0.28 < x < 0.35$. This results in a change in λ_c in the range from ~ 8 to 11 μm . These preliminary results show only a fraction of the accessible parameter space on the growth of Ga-free SL but already indicate their potential in strain engineering and wavelength tunability in the MIR.

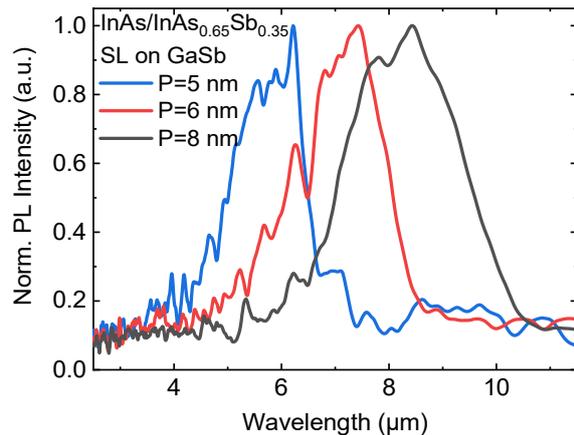


Fig. 1 RT PL measurement of InAs/InAs_{0.65}Sb_{0.35} samples with periods P between 5 and 8 nm having cut-off wavelengths between ~ 7 and 11 μm .

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