
ICFO
Monomer Concentration Control Approach
InSb nucleus
InSb monomer
Precursors injection
1 Nucleation: Fast injection
Two precursors ($InCl_3$ and $Sb[NMe_2]_3$) are injected rapidly (1 ml/min) into the system. When mixed, they react to form many InSb molecules called monomers. Once monomer concentration is high enough (saturated solution), they spontaneously cluster together to produce InSb nuclei. These are the seeds that will then grow into bigger quantum dots.
After 30 seconds, the injection rate considerably drops down (0.1 ml/min), reducing the concentration of new monomers. Under these conditions, monomers cannot form new nuclei; instead, they attach to the surface of the existing ones. In this way, nuclei grow uniformly during 15 minutes, developing into large-size quantum dots.
2 Growth: Slow injection
InSb quantum dot
The resulting quantum dots are large and uniform, enabling absorption at longer wavelengths and reaching the Shortwave Infrared (SWIR) regime. This makes the MCCA method a promising route toward high-quality SWIR photodetectors.
3 New results
Traditional
Continuous-injection approach
2 Growth: Fast injection
Continued precursor injection at a constant high rate generates an excess of monomers. The majority form new InSb nuclei, while the remainder incorporate onto existing ones, driving their growth. Consequently, newly formed nuclei have less time to grow than older ones, which generally results in a broad size distribution.
3 Traditional results
The resulting quantum dots have variable sizes that are generally smaller than those produced by the MCCA. Consequently, their absorption spans a broader wavelength range but does not extend into the SWIR regime.