# Towards coherent and scalable O-band quantum emitters

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A high-fidelity single photon source is a key component for photonic quantum devices. Quantum dots (QDs) set the benchmark for other quantum emitters thanks to their ability to deliver high-quality, high-rate and high-purity single photons. However, achieving these exceptional capabilities at telecommunications wavelengths and bridging the gap to fibre-optic infrastructure and scalable silicon photonics remains challenging. Overcoming this difficulty requires high-quality quantum materials and devices.

In this study, we present waveguide-integrated indium arsenide (InAs) quantum dots and outline our approach to realising a quantum-coherent photon–emitter interface operating in the O-band (1260–1360 nm). We measure single photons at a high rate with near transform-limited characteristics [1].

These results were achieved using conventional Stranski–Krastanov (SK) InAs QDs overgrown with a strain-reducing layer to shift the emission wavelength into the O-band. However, this SK approach faces challenges in achieving the low, well-controlled densities of 0.1–10 QDs/µm² required for fabricating single-photon sources. We present an alternative approach based on local droplet etching to address the density issue, in which nanoholes in a GaAs matrix are filled with InAs to form QDs [2]. The density of the quantum dots is defined by the nanohole pattern, enabling precise and scalable control. Homogeneous, low-density (~2 QDs/µm²) growth is achieved through shutter-synchronised deposition (Fig. 1), making this approach ideal for the scalable fabrication of single photon sources (SPS) [3]. We detail the fabrication method and present structural and optical characterisation results.

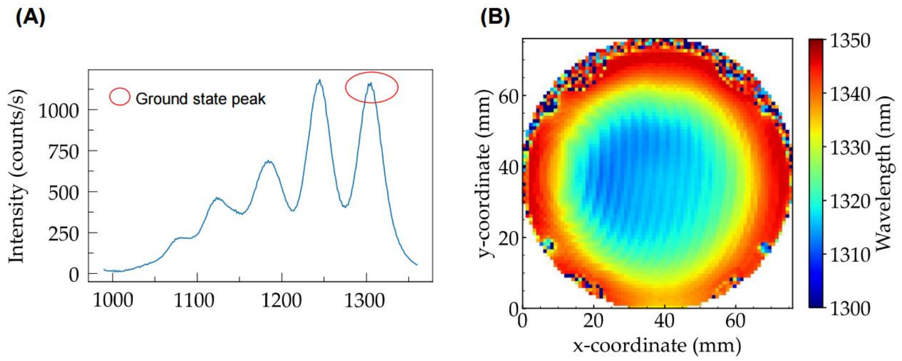


Fig. 1. (A) Photoluminescence (PL) spectrum recorded at the centre of the wafer at 80 K. (B) PL map showing the ground-state peak wavelength across a full 3" wafer.

[1] Albrechtsen et al., https://arxiv.org/abs/2510.09251v1

[2] N. Spitzer et al., Crystals **14**, 1014 (2024).

[3] E. Kersting et al., Nanomaterials **15**, 157 (2025).