Quantum dots for low noise single photon sources

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A key component for photonic quantum devices is a source of high-fidelity photonic qubits, a single photon source. A promising route to create such a device employs semiconductor quantum dots (QDs) in photonic cavities.

However, noise processes hampering solid state emitters [1]. A main contributor to decoherence and low efficiency is random charge rearrangements in the semiconductor environment or the QD itself. A random change of the QD's charge state from e.g. Auger processes [2] or photoionization [3] can switch the emitter temporarily off [2,4].

One way to efficiently suppress charge noise, is to embed the QDs in the high purity material undoped region of a p-i-n-[5,6] or n-i-n-[7] diode tunnel-coupled to a charge reservoir. We successfully apply this method [8,9] to highly promising strain free local droplet etched GaAs-QDs [10,11] and discuss these QD's advantages.

We now turn to epitaxial growth control of our QDs. Wafer rotation stop enables material gradient growth. Newly discovered implications of this well-known method like a periodic modulation of the QD density [12] and QD-emission wavelength [13] will be presented.

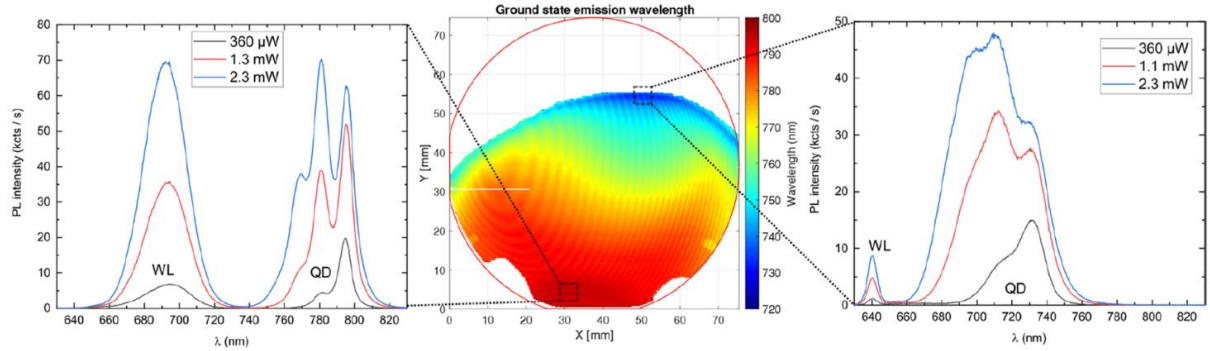

Figure 1: (centre) QD photoluminescence ground state peak emission wavelength recorded on a full 3"-wafer at T = 100 K. The emission is modulated due to material gradient deposition. (left and right) Photoluminescence spectra taken at the positions indicated in the centre map measured at the indicated laser power. The QDs show a clear level structure. A thin GaAs quantum well (WL) is emitting in the red spectral range.

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