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Growth scheme for quantum dots with low fine structure splitting at telecom wavelengths

Tina Müller[1], Joanna Skiba-Szymanska[1], R. Mark Stevenson[1], Christiana Varnava[1,2], Martin Felle[1,2], Jan Huwer[1], Anthony J. Bennett[1], James P. Lee[1,2], Ian Farrer[3,4], Andrey Krysa[4], Peter Spencer[3], Lucy E. Goff[3], David A. Ritchie[3], Jon Heffernan[4], Andrew J. Shields[1]

[1]*Toshiba Research Europe Limited, 208 Science Park, Milton Road, Cambridge CB4 0GZ, UK*
[2]*Cambridge University Engineering Department, 9 J J Thomson Avenue, Cambridge CB3 0FA, UK*
[3]*Cavendish Laboratory, University of Cambridge, J J Thomson Avenue, Cambridge CB3 0HE, UK*
[4]*Department of Electronic and Electrical Engineering, University of Sheffield, Sheffield S1 3JD, UK*

Quantum dots based on InAs/InP hold the promise to deliver entangled photons with wavelength suitable for the conventional telecom window around 1550 nm [1]. This makes them predestined to be used in future quantum networks applications based on existing fiber optics infrastructure. A prerequisite for the efficient generation of such entangled photons is a small fine structure splitting (FSS) in the quantum dot excitonic eigenstates [2], as well as the ability to integrate the dot into photonic structures to enhance and direct its emission. Using optical spectroscopy, we show that a growth strategy based on droplet epitaxy can simultaneously address both issues.

Contrary to the standard Stranski-Krastanow technique, droplet epitaxy dots do not rely on material strains during growth, which results in a drastic improvement in dot symmetry. As a consequence, the average exciton FSS is reduced by more than a factor 4, which in turn increases the probability of finding a dot with FSS below 15 μeV from less than 1 in 1000 to 1 in 10, as extracted from the statistics shown in Fig. 1.

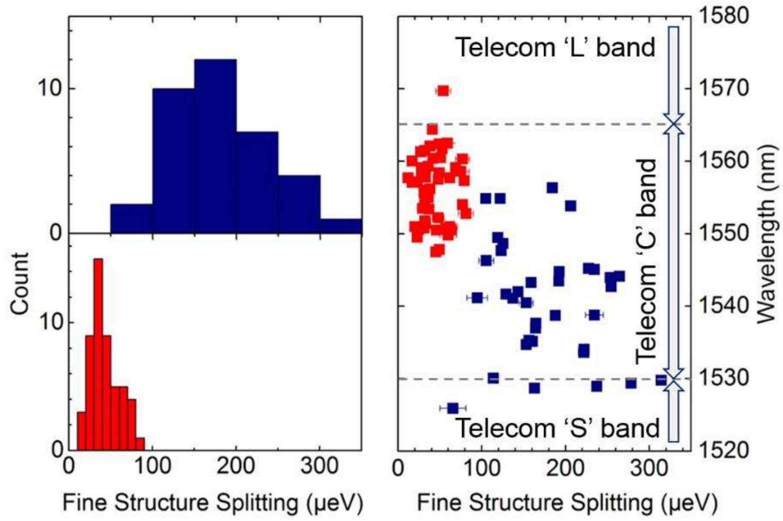

Figure 1: FSS statistics on S-K QDs and droplet epitaxy QDs emitting in the telecom 'C' band.

Furthermore, we demonstrate that droplet epitaxy dots can be grown on the necessary surface (001) for high quality optical microcavities, which increases dot emission count rates by more than a factor of five. The droplet epitaxy dots show no preferred wavelength for low FSS (see Fig. 1), instead, the wavelength distribution is dictated by the cavity central wavelength. Together, these properties make droplet epitaxy quantum dots readily suitable for the generation of entangled photons at telecom wavelengths.

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