Telecom-band single photon sources monolithically grown on silicon

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Securing communications over long distances requires bright single photon sources emitting in the telecom band in a well-defined spatial and polarization mode.

First, we report our efforts to obtain single photon emission and a Gaussian far-field radiation pattern in the telecom O-band from single quantum dot-nanowires (QD-NWs) monolithically grown on silicon. The InAs/InP QD-NWs were grown on silicon (111) substrates by Vapor-Liquid-Solid assisted solid-source Molecular Beam Epitaxy using In-Au droplets as a catalyst in-situ deposited at 500°C [1]. Low QD-NW density was obtained by a careful control of the In/Au catalyst flux ratio to achieve density <1 NW/µm² [2]. The growth conditions have been tuned (Fig 1.a) to optimize the source brightness and reduce the far-field divergence. The control of the nanowire geometry allows us to demonstrate a Gaussian far field emission profile with an emission angle θ≈30° (Fig 1.c) from a single QD at room temperature in the telecom O-band and the observation of single photon emission with $g^2(0) = 0.05$ (Fig 1.b) at cryogenic temperature [3].

Secondly, we have optimized the growth procedure to achieve InAs/InP QD-NWs with an elongated top-view cross-section. Polarization-resolved photoluminescence measurements have revealed a significant influence of the asymmetric shaped NWs on the InAs QD emission polarization with the photons being mainly polarized parallel to the NW long cross section axis [4]. A degree of linear polarization (DLP) up to 91% is obtained, being at the state of the art for the reported DLP values from QD-NWs.

References

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Figures

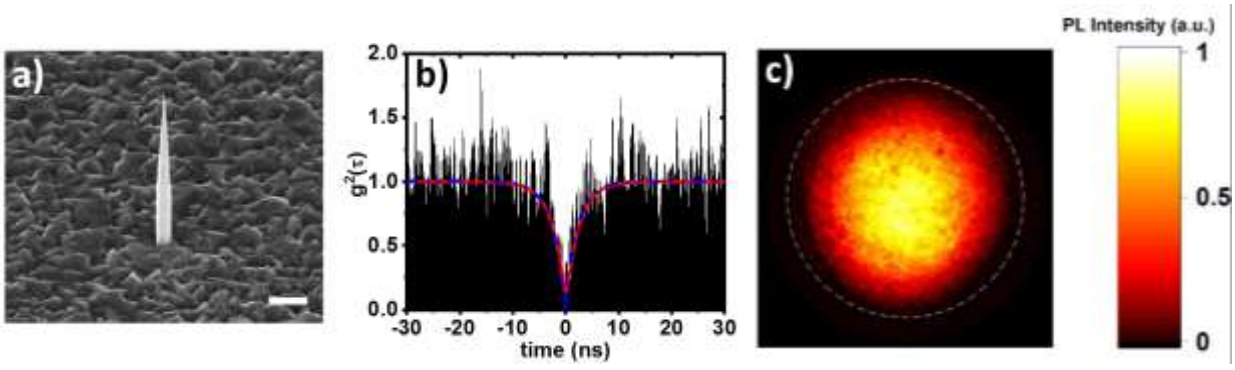

Figure 1: a) Single InAs/InP QD-NW with a needle-like geometry. b) Second order correlation measurement of a single QD emitting at 1328 nm at cryogenic temperature. c) Far-field emission profile of a single QD-NW at room temperature [3].