Near room temperature emission from single (211)B InAs QD and clear antibunching behaviour up to 60K

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We propose here a new system based on epitaxial self-assembled InAs/GaAs quantum dots (QDs), grown on a high-index (211)B GaAs substrate. This system incorporates all the well-known benefits of standard (100) InAs/GaAs QDs and in addition possesses a fascinating characteristic: the presence of a huge vertical piezoelectric (PZ) field inside the QDs, bringing in a number of significant advantages. First, the PZ field preserves the high symmetry of the confining potential, leading to negligible fine structure splitting values in this system [1], which is essential for entanglement applications. Second, it generates large exciton-biexciton splittings which allow for single photon applications at high temperatures. Towards this end, we report here temperature-dependent photoluminescence (PL) measurements on (211)B InAs single QDs, embedded inside GaAs/AlAs short-period superlattices, enhancing carrier confinement and allowing high temperature emission, as well as preliminary findings from photon anti-bunching experiments up to 60K from a PZ QD.

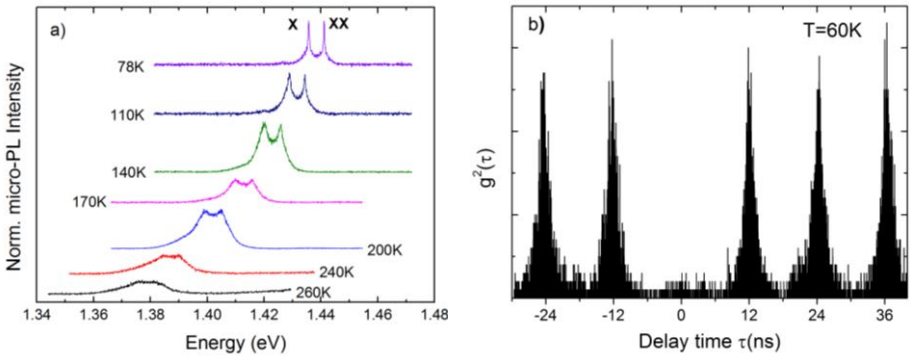

Figure 1.a): Temperature dependent μ-PL spectra from a single PZ InAs QD, embedded in GaAs/AlAs short-period superlattice, showing emission up to 260K. b): Second order correlation function $g^2(\tau)$ measured on exciton line at 60K .

As can be seen from Fig.1a, the exciton-biexciton (X-XX) doublet with energy difference about 5.38meV from a single QD remains visible up to 260K, in spite of line broadening due to phonon and spectral diffusion effects. Arrhenious plots of PL intensities show activation energies ≥180meV which correspond well to the difference between energy positions of wetting layer and QD emission. To our knowledge, this is the first time that the X and XX emission from a single InAs QD is resolved at such high temperatures. In Fig.1b, a clear photon anti-bunching behavior from a single piezoelectric QD at 60K is depicted and we strongly feel that this preliminary result is a first step towards achieving practical single photon emitters at room temperature.

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Reference

[1] S. Germanis et al., Phys. Rev. B., 86, 035323 (2012)

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