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Total number of authors:
13

Publication date:
2024

Document Version
Publisher's PDF, also known as Version of record

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Epitaxial quantum dots (QDs) exhibit substantial promise as non-classical light sources in quantum technologies [1]. In particular, the generation of single, indistinguishable photons on demand is pivotal for advanced quantum cryptographic key exchange algorithms [2]. This study investigates the quantum optical characteristics of single photons emitted by InAs(P)/InP QDs heterogeneously integrated with silicon.

The investigated QDs, grown via metalorganic vapor-phase epitaxy in the Stranski-Krastanow mode, showcase the emission at ~1.55 μm [3], indispensable for long-haul, low-loss optical transmission through standard silica fibers. The photon extraction efficiency is enhanced to ~10% by employing a metallic mirror beneath the QDs in combination with a top mesa structure [4]. Our study confirms the single-photon emission from the QDs through measurements of the second-order autocorrelation function, revealing $g^{(2)}(0) = 0.005(4)$ for biexciton under two photon resonant excitation of the biexciton-exciton radiative cascade.

To investigate the degree of indistinguishability of emitted photons, we conducted also Hong-Ou-Mandel-type two-photon interference (TPI) experiment. The TPI visibility, quantifying the degree of indistinguishability of emitted photons, is crucial in examining the coherence of carriers within the QD [5]. Exciton-phonon interactions and carrier-carrier scattering significantly contribute to the degradation of coherence within the QDs. Using direct integration of the raw experimental data or fitting to a model, we evaluated the raw (i.e., 'as measured') and the post-selected TPI visibility up to 35% and 73%, respectively [6], which represents a state-of-the-art achievement for InAs/InP QDs emitting at 1.55 μm. The significant progress in the generation of single indistinguishable photons in the telecom C-band offers crucial insights into their potential integration within quantum information technologies.

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