Integration of telecom C-band quantum dot light sources with silicon-based photonic integrated circuits

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Silicon-based quantum photonics has garnered much attention recently. The optical transparency and the large refractive index contrast of silicon at telecommunication wavelengths allow the implementation of high-density photonic integrated circuits. One disadvantage of silicon quantum photonics is the lack of mature bright deterministic light sources. One potential solution is the integration of III-V material, which offers outstanding optical emission properties, on a silicon platform.
Our group has previously developed telecom C-band emitting InAs quantum dots grown on InGaAs [1]. Here, we report our approach to designing and fabricating structures for the hybrid integration of these QDs onto a silicon platform using micro-transfer printing.
Moreover, we report also on adhesive bonding, which is a scalable and flexible method for achieving this integration. It provides and enables lithography-defined alignment. This part focuses on integrating an InGaAs membrane with C-band InAs QDs onto a Si photonic platform using an optimised adhesive bonding scheme.
Finally, we will present a C-band source of polarization entangled photons based on a quantum dot incorporated in a planar cavity structure. In this way, triggered emission of entangled photon pairs with a coincidence rate of 201 kcps (biexciton/exciton fiber-coupled single-photon count rates of 5.0 Mcps/ 2 Mcps) combined with g(2)(0) values of 0.009/0.015 is achieved. Full quantum state tomography of the two-photon state demonstrates simultaneously entanglement fidelities of up to 0.96 to the Φ+ Bell state.

[1] S. L. Portalupi, M. Jetter and P. Michler, Semicond. Sci. Technol. **34**, 053001 (2019) and references therein.