Plug-and-play quantum light from semiconductor quantum dots in fiber-pigtailed hybrid circular Bragg gratings

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Semiconductor quantum dots (QDs) in hybrid circular Bragg gratings (hCBGs) are close to ideal sources of bright, pure and indistinguishable quantum light [1,2], a key requirement for photonic quantum technologies. Additionally, attempts to generate quantum light from directly fiber-interfaced QDs in compact source arrangements, so-called 'plug-and-play' single photon sources [3] show prospects of readily providing quantum light without the need of bulky laboratory infrastructure. To date, however, no plug-and-play source harnessing the high performance of QD-hCBG systems has been realized.

In this contribution, we report on the fabrication of hCBGs with deterministically integrated QDs spatially and spectrally matched to the cavity mode. The QDs exhibit lifetimes <50 ps under (quasi-)resonant excitation, resulting in Purcell Factors >20, showing near-ideal spectral and spatial QD integration with high reproducibility in combination with single photon purities >98% under quasi-resonant pumping and two photon- indistinguishabilities >88% without post-selection under resonant excitation.

We further demonstrate the deterministic fiber-pigtailing of these high performance quantum light sources, resulting in plug-and-play devices with emitter lifetimes <100 ps, single-photon purites >99% and MHz countrates. In combination with compact cryocooler technology and advanced fiber-compatible excitation schemes, these fiber-pigtailed QD-hCBG systems hold the promise to provide state-of-the art quantum light in out-of-laboratory scenarios.

References

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