Bragg-Reflection Waveguides for Quantum Frequency Conversion

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Single-photon sources emitting at telecom wavelengths are a key component of quantum communication networks. Currently, InAs/GaAs quantum dots are among the best-performing and well-understood solid state quantum emitters, creating photons in the 900-950nm wavelength range. To bridge this gap, quantum frequency conversion can be used to obtain single photons at 1550nm, while maintaining the favourable properties of the quantum dots, like high single photon purity and indistinguishability.

We propose an on-chip quantum frequency converter for such InAs quantum dots, based on AlGaAs Bragg-reflection waveguides (BRWs). These multilayer structures achieve efficient frequency conversion through modal phase matching of three-wave mixing processes in a strongly nonlinear AlGaAs waveguide core. As opposed to other waveguide or bulk crystal approaches, the quantum dots can be monolithically grown directly inside the BRW [1].

We present design, fabrication and first optical characterisation results of Bragg-reflection waveguides for difference frequency generation of telecom C-band photons from 900nm pump photons and a 2145nm seed laser. Following an improved fabrication procedure with a new etch recipe, we were able to improve the sidewall roughness of our waveguide ridges resulting in reduced propagation losses, compared to previous samples [2]. This results in a higher conversion efficiency, further affirming their application as bright, integrated single-photon sources at telecom wavelengths.

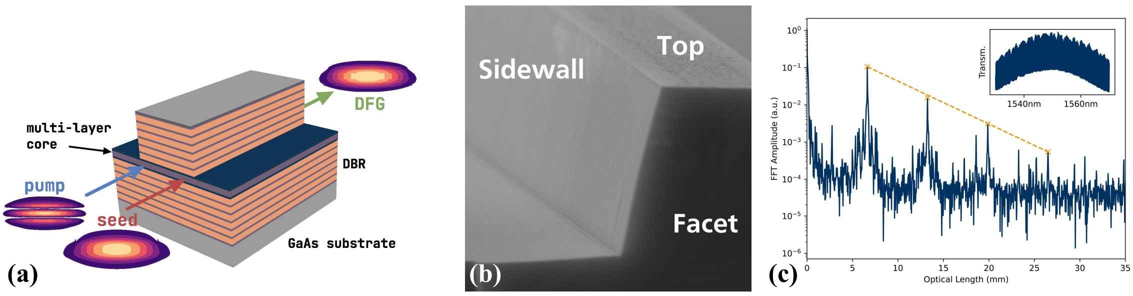

Fig. 1: (a) *Multilayer structure of a Bragg-reflection waveguide for difference frequency generation (DFG) with simulated mode shapes of the phase-matched fields.* **(b)** *SEM image of an etched waveguide with straight and smooth sidewalls.* **(c)** *Propagation loss measurement at 1550nm using Fourier analysis of the transmission spectrum [3].*

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References

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