Design and fabrication of a silicon nitride ring resonator for on-chip broadband entangled photon sources

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Quantum entanglement in chip scale has been attracting the recent research interests. With the standard CMOS technology, it is possible to realize entangled photon sources in optical nonlinear micro ring resonators on the platform of silicon[1] or silicon nitride[3]. In order to extend the frequency entanglement range, i.e., to satisfy a broadband phase matching condition, it is essential to take the group velocity dispersion (GVD) into consideration during the four wave mixing process.

We first measured the GVD for various kinds of SiN films deposited by liquid source (LS) CVD[2], low pressure (LP) CVD and plasma enhanced (PE) CVD. For the GVD estimation, in addition to the ellipsometry, we analyzed the changes in the free spectrum range (FSR) of ring resonators fabricated using the films.

Then, we numerically simulated the GVD of the ring resonators and found that a ring resonator with a radius of 200 μm using LS-CVD SiN films with the thickness greater than 800 nm, can satisfy the required phase matching condition in a broad band. Then we fabricated a ring resonator using the LS-CVD 800nm-thick SiN film. The transmission spectrum of the device is shown in the figure and the Q factors are up to 8×10^4. We also found that the estimated GVD is flat and positive between about 1560 nm and 1620 nm, suggesting the possibility of broadband generation of entangled photons in this region.

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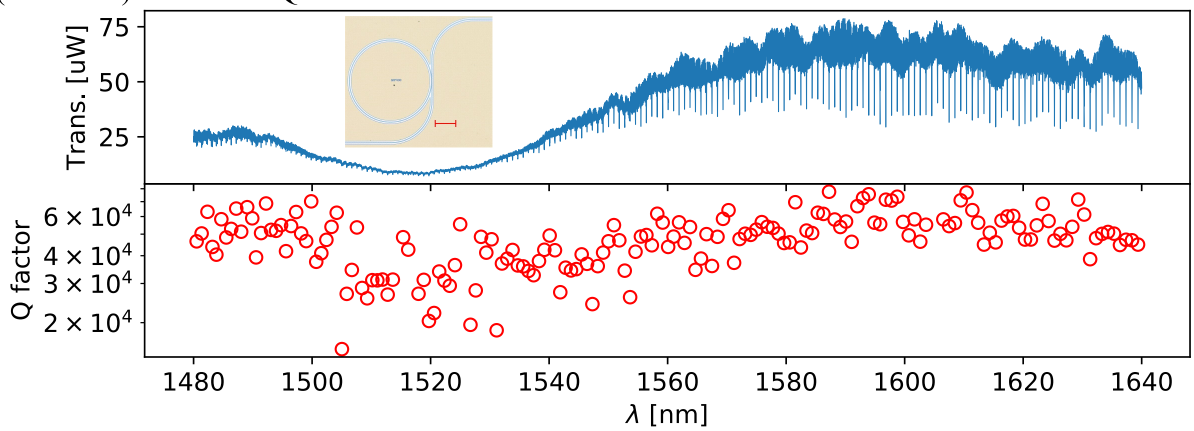

Figure 1: **Transmission spectrum and *Q* factors in the SiN ring resonator**, range from S band to L band that is taken from the output side while the input power is 1 mW. The scale in the inset figure is 100 μm.

References

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