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A silicon nitride platform for integrated quantum technologies

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Silicon nitride (SiN) stands out as a promising material for the fabrication and design of integrated photonic devices applicable to precision spectroscopy, telecommunications, and quantum optical communication. Notably, SiN demonstrates low losses, high nonlinearities, and compatibility with existing CMOS technology. We will report on our lab's optimized process, guiding quantum devices from the fabrication stage to optical characterization.

Our methodology employs low-pressure chemical vapor deposition to generate stoichiometric silicon nitride. Notably, removing the backside of the nitride from the wafer significantly impacts achieving nominal values for the refractive index [1]. Understanding how the index changes with wafer and fabrication processing proves critical for predicting correct geometries and the associated group velocities required for realizing novel quantum technologies. The quantified propagation loss of our devices is measured at 1.2 dB/cm, with coupling losses at 2 dB/facet, aligning with the current state-of-the-art.

Furthermore, we've conducted device modeling and theoretical simulations to predict device performance. We employed the Lugiato-Lefever Equation, solving it using the split-step Fourier method [2]. Guided by our theoretical predictions, we initiated the fabrication of new resonators for optical frequency combs and solitons, subsequently moving these newly fabricated devices to the lab for characterization.

In conclusion, I will discuss how our progress in developing these novel devices can be applied to exciting applications [3].

[1] A. M. Tareki, et al., IEEE Photonics Journal. 15, 1-7, (2023) [2] T. Hansson, et al. Optics Communications, 312, 134-136 (2014) [3] M.A. Guidry, et al. Nat. Photon. 16, 52–58 (2022).

Keyword-1

Quantum Communications

Keyword-2

Photonic Devices

Keyword-3

Optical Resonators

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