Low-loss 200-mm SiN platform for 925 nm photonic quantum computing

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SiN photonic integrated circuits are used in quantum photonic applications because of low propagation losses and scalable CMOS manufacturing [1]. The 925 nm wavelength is of particular interest for quantum computing as deterministic single photon sources are available at this wavelength, *e.g.* made of InAs quantum dots in microcavities [2-3]. To be useful for quantum applications, all photonic losses need to be minimal, including the challenging low-loss fibre-to-chip coupling [4].

A SiN platform dedicated to 925 nm photonic quantum computing applications was developed, fabricated and characterized in CEA-Leti's pre-industrialization clean room facility on 200-mm wafers. The different layer thicknesses were optimized for efficient fibre-to-chip coupling via edge couplers and compact low-loss photonic devices, allowing for bends with radii under 40 µm. We measured the following losses at 925 nm:

device	**losses**
fibre-to-chip interface	0.5 dB
direction couplers	< 0.01 dB
1x2 multi-mode interferometer	0.04 dB
single mode waveguide	0.9 dB/cm
multimode waveguides	0.3 dB/cm

The losses of the fibre-to-chip interface were measured with a standard 780HP single mode fibre, in index matching liquid and with a 925 nm CW laser. This platform provides building blocks for photonic quantum computing circuits, and we expect the total losses of a 20-mode reconfigurable quantum processor to be beneath 2 dB. Targeting fault-tolerant quantum computing, the platform foresees the integration of LN modulators and waveguide-integrated SNSPD on its next generation quantum computing circuits [5].

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