Suspended Silicon Photonic Platform for On-Chip Quantum Photonics with Color Centers

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Silicon color centers, in particular T- and G-centers, are emerging as promising solid-state quantum emitters due to their telecom O-band zero-phonon lines and, in the case of T-centers, ground state spin splitting, making them attractive for fiber-compatible quantum networks. However, scalable integration of such emitters with low-loss and reconfigurable photonic circuitry remains challenging, particularly in platforms that enable efficient light–matter interaction. In this work, we present a suspended silicon photonic platform for integration with silicon color centers, enabling key building blocks for quantum photonics. We demonstrate building blocks, such as suspended single-mode waveguide, low-loss suspended support structures with transmission of 99% per tether, and edge-coupling structures with 10% coupling efficiency to standard SMF-28 fibre. We also implement integrated 50:50 beam splitters and stable directional couplers, compatible with on-chip correlation and interference measurements. In addition, we realize interferometric structures and ring resonators for future filtering, switching, and routing of quantum light. Importantly, we observe photoluminescence from G-centers integrated within the suspended photonic structures. These results establish a scalable platform for integrating telecom-wavelength quantum emitters with low-loss photonic circuits, enabling on-chip manipulation of single photons for future quantum photonic networks.

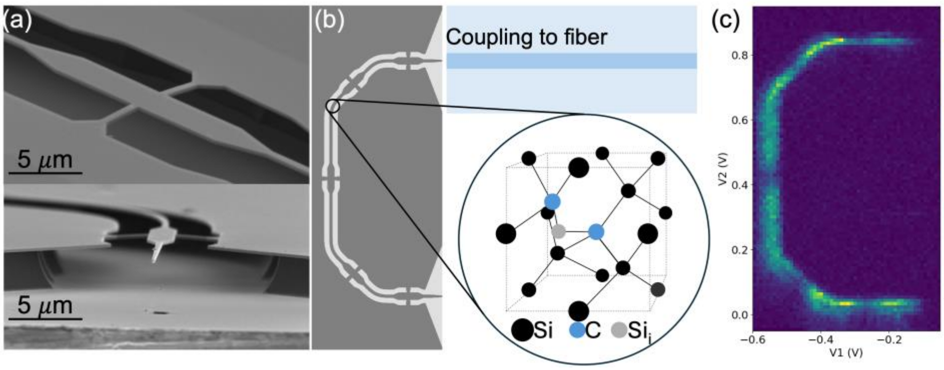

Fig. 1:*(a) SEM images of building blocks: tethers (top) and edge coupler (bottom); (b) schematic of the measured device: a suspended waveguide. The sample contains G-centres (inset), consisting of two substitutional carbon atoms and one silicon self-interstitial; (c) G-centre photoluminescence map. V1 and V2 are galvanometer mirror voltages controlling the excitation spot position for continuous-wave green excitation.*