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Subwavelength engineering of silicon photonics for nonlinear applications

(Invited paper)

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Abstract— Periodically patterning silicon with a subwavelength pitch opens new degrees of freedom to control light propagation in silicon photonic circuits with unprecedented flexibility. Here we present our most recent results on the use of subwavelength engineering for applications in nonlinear light generation.

Keywords—silicon photonics; subwavelength; Kerr; photon-pair source; supercontinuum

The strong Kerr coefficient of silicon makes it a promising candidate for on-chip nonlinear generation of new optical frequencies, with a plethora of applications in fundamental and applied physics.

In the near-infrared (near-IR), Kerr nonlinearities are exploited for the implementation of photon-pair sources capable of generating multi-spectral entangled photon-pairs [1]. However, the substantially higher pump intensity and narrow wavelength separation between the photon-pairs and the optical pump impose stringent requirements that lie well-beyond capabilities of state-of-the-art silicon spectral filters. In this invited talk we will present an overview of our recent advances in the field of waveguide Bragg gratings for photonic noise reduction in silicon photon-pair sources, including the demonstration of a silicon photon-pair source with integrated pump-rejection filter achieving high visibility [2].

On the other hand, the wide transparency range of silicon (1.1-8 μm wavelength) and the negligible two-photon absorption for wavelengths above 2 μm , make this technology a very promising candidate for supercontinuum generation in the mid-IR. However, the use of the silicon-on-insulator technology in the mid-IR is limited by the absorption of the silica cladding for wavelengths above 3.5 μm . Suspended silicon waveguides with metamaterial grating cladding allow overcoming the silica absorption limitation [3], while providing additional degrees of freedom in controlling waveguide dispersion. Here we will present our most recent results on the use suspended silicon waveguides for supercontinuum generation in the near-IR and mid-IR. As an example, Fig. 1 shows measured supercontinuum generation in a suspended silicon rib waveguide, expanding between 2.5 μm and 7 μm wavelength.

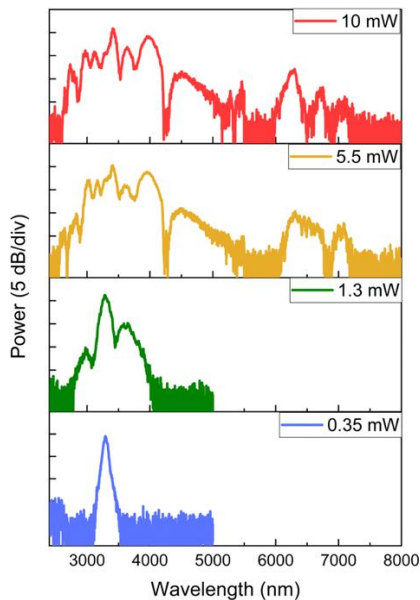


Figure 1: *Experimental characterization of supercontinuum generation in suspended silicon rib waveguide.*

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