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Integration of Mid-index Silicon Nitride Platforms for CMOS Photonic Circuits

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Abstract: We present our progress in the demonstration of novel material integration schemes that facilitate the incorporation of mid-index silicon nitride platforms with a variety of refractive indices in CMOS compatible photonic integrated circuits. The integration of such materials enables the realization of linear and nonlinear devices for a variety of applications, including telecom and all-optical processing.

In recent years, silicon nitride (SiN) platforms with a mid-refractive index (1.7-3.1) have gained interest for the demonstration of photonic integrated circuits. They offer full CMOS compatibility with low propagation losses and flexible optical properties that can be tailored to achieve linear and nonlinear properties suited for a wide range of applications [1-2]. In this work, we present our progress in the incorporation of silicon nitride with two distinct refractive indices for the realisation of advanced telecom and all-optical processing devices [3-4]. Our work includes a novel butt-coupling integration scheme between micro-meter scale SiN and silicon-on-insulator (SOI) waveguides based on N-rich SiN layers with a refractive index of 1.88 at 1310nm. This scheme has been used to seamlessly interface SiN (de)multiplexers with SOI circuits and can be further exploited to integrate active devices with thick material stacks that are often difficult to integrate with thin SOI geometries. We have also demonstrated a Si-rich SiN platform with a refractive index of 2.41 at 1550nm with an enhanced nonlinear Kerr coefficient, negligible two-photon absorption, and low propagation loss. This platform has enabled the demonstration of a fully integrated four-wave-mixing based wavelength converter in the C and L wavelength bands for all-optical signal processing.

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