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Erbium-doped silicon nitride integrated photonics – from amplifiers to ultrafast mode-locked lasers

Erbium ions provide an exceptional gain medium for integrated photonics, offering long excited-state lifetimes, low noise, slow gain dynamics, and excellent temperature stability. Combined with the wide transparency and low-loss properties of silicon nitride, they enable high-performance optical amplification and lasing directly on chip.
In this talk, I will present our recent advances in erbium-doped silicon nitride photonic integrated circuits, enabled by scalable ion implantation. Our amplifiers achieve over 240 mW on-chip output power and >28% power conversion efficiency—surpassing prior integrated gain platforms. Building on this, we demonstrate continuous-wave lasers with intrinsic linewidths below 100 Hz, full C+L-band tunability across 91 nm, and robust operation up to 125 °C.
We further realize the first integrated Mamyshev oscillator, generating 161 pJ femtosecond pulses at 185 MHz, leveraging self-phase modulation and spectral filtering in an erbium-doped cavity. These results showcase Er:Si_3N_4 as a versatile, scalable platform for coherent communication, sensing, and ultrafast on-chip photonics.

References

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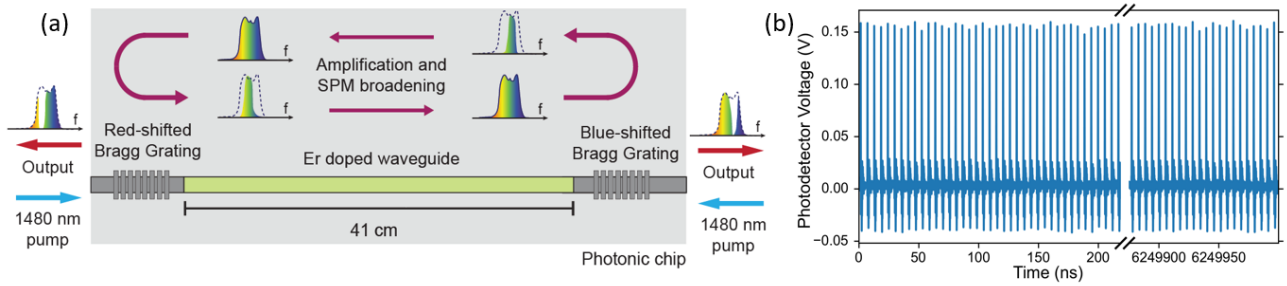

Figure 1: a) Schematic illustration and b) pulses generated of an integrated Mamyshev oscillator built using erbium doped silicon nitride technology.