Nonlinear integrated optics on lithium niobate for sensing applications

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Waveguides and integrated optical devices such as modulators, Bragg filters and nonlinear frequency converters are key components for next generation optical communications. In addition to standard lithographic techniques, femtosecond laser writing is nowadays recognized as a powerful tool to realize optical elements in various materials including glasses, crystals and ceramics. Particularly with respect to direct integration of functional optical devices, it is indispensable to realize waveguide structures, couplers, and gratings in nonlinear optical materials to exploit their inherent reconfigurability. However, the intrinsic anisotropy of such nonlinear host materials as e.g. lithium niobate requires complex writing schemes to realize symmetric, low loss guiding.

In this contribution, we will present a hybrid design that consists of circular type-II waveguides combined with embedded type-I Bragg gratings. The structure supports both, ordinary and extraordinary polarized modes. Second order Bragg gratings are inscribed into the waveguide core using a multiscan technique with high transverse resolution, and narrow-spaced integrated electrodes allow tunability. We demonstrate low loss symmetric guiding, narrowband reflections in the C-band, and high bandwidth spectral tuning [1].

In the endeavour to realize efficient nonlinear second harmonic generation, waveguides provide high power density and long interaction lengths. We will demonstrate monolithic fabrication of laser-induced quasi phase-matching waveguides with efficient second harmonic generation [2]. In contrast to classic schemes where periodically poled nonlinear crystals are employed, we directly inscribe the periodic modulation of the effective nonlinearity into the waveguide core.
