Zinc Indiffused Diced Ridge PPLN Waveguides for Photorefractive Damage Resistance and Spectral Engineering

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Nonlinear devices have been essential for extending laser wavelength operating ranges since its invention. The ability to convert a laser's wavelength between the telecoms C-band and 780 nm has attracted much attention recently due to the developments of magneto-optical traps using Rb aimed at high precision gravity measurements and quantum optics for generating entangled photon pairs. For magneto-optical traps the low linewidths and low cost optical components from well established telecoms technology have enabled the efficient generation of all the small frequency shifts required to address the excitation states of the Rb. Nonlinear waveguides based on direct bonded lithium niobate on lithium tantalate have demonstrated highest efficiency second harmonic generation (SHG) of telecoms lasers [1], but are difficult to fabricate. Ti indiffused waveguides have been shown as an alternative, but it has been shown recently that photorefraction limits the performance of these waveguides to less than 10 mW [2].

Our Zn indiffused waveguides are realised by creating a waveguide directly from periodically poled lithium niobate and have $<$ 2dB insertion loss. The waveguide's vertical confinement is created by a zinc based indiffusion at a temperature below the crystal's Curie point and the lateral confinement is created by physical machining in the ductile regime to create optical quality cuts [3]. In contrast to Ti indiffusion, the presence of Zn in the nonlinear crystal reduces its susceptibility to photorefractive damage [1,2], enabling output powers $>$ 100 mW.

Fig 1(a) shows a typical SHG spectra measured when launched with 300 mW of input power, compared with a measured spectra (right) from a custom apodised grating waveguide which suppresses the sinc lobe features. Fig 1(b) shows SHG output vs. launched 1560 nm light for one of our 40 mm long waveguides using a commercial EDFA seeded with an tunable laser; the inset shows the output spectra at the maximum power of 925 mW launched with a peak SHG output of 130 mW. Fig 1(c) show a photograph of one of our 40 mm devices, the illuminating light is highlighting the presence of the periodically poled domain structure towards the right.

We will present our latest work on Zn indiffused ridge waveguides with approaches for increasing the efficiency at higher powers and customising the spectral output using apodization of the periodically poled domain structure.

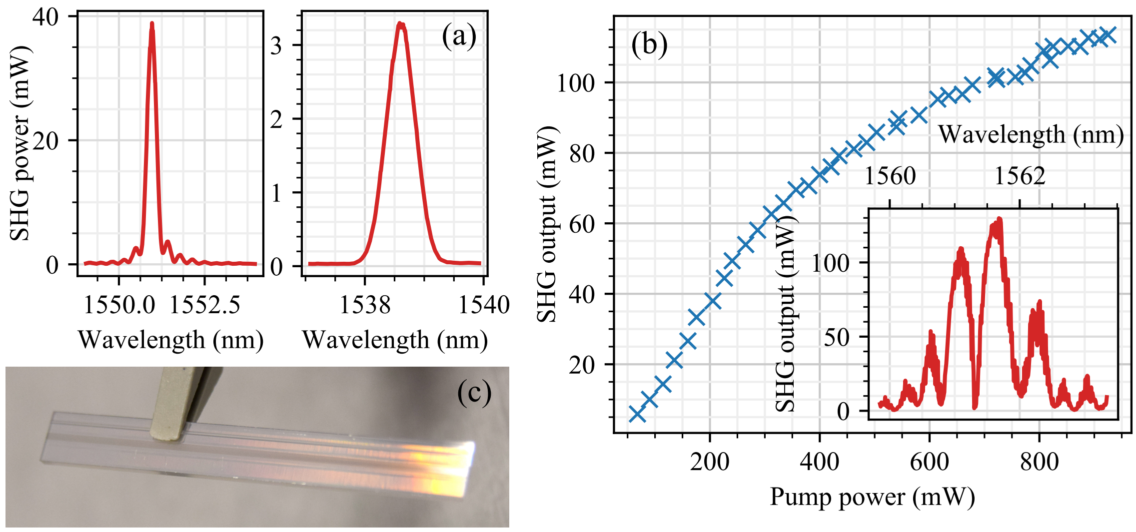

Fig. 1 (a) SHG output spectra from the PPLN waveguide with 300 mW of input power. (b) The SHG output scaling with launched pump power (inset shows the spectra at 925 mW pump power). (c) A photograph of one of the 40 mm chips containing 5 Zn indiffused ridge waveguides.

References

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