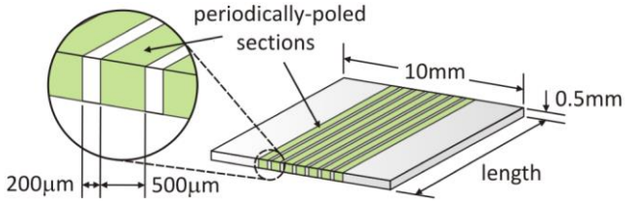
Frequency Doubling Er^{3+} Femtosecond Lasers

Introduction of MgO:PPLN

PPLN and MgO:PPLN are nonlinear optical crystals for high efficiency wavelength conversion in the 460nm – 5100nm range. Our proprietary PPLN poling process creates high fidelity grating periods from 4.5µm to 33µm and is ideal for high volume manufacture.

Crystal lengths are 0.3mm to 1mm for short-pulse femtosecond lasers and 10mm to 40mm for ns to CW systems. Our standard crystals are supplied clip-mounted and off-the-shelf. Custom crystal lengths, thicknesses, AR coatings, and grating designs are also available upon request.

Standard PPLN crystal layout



- Multiple periods for broad wavelength range
- Crystals supplied mounted for easy handling
- Multi-band AR coated

Femtosecond laser doublers

part #	pump (nm)	output (nm)	grating periods (µm)	temperature tuning range (°C)	thickness (mm)	lengths (mm)
MSHG1550-0.5	1530 – 1620	765 – 810	18.50, 18.80, 19.10, 19.40, 19.70, 20.00, 20.30, 20.60, 20.90	30 – 200	0.5	0.3, 0.5, 1, 3, 5, 10
MSHG1550-1.0	1545 – 1610	773 – 805	19.20, 19.50, 19.80, 20.10, 20.40	30 – 200	1.0	0.5, 1, 3, 5, 10

How to choose a crystal

The crystal length is an important factor when choosing a crystal due to the acceptance bandwidth of the device. The crystal needs to be long enough to achieve good temporal overlap of the pulses, and yet short enough to accommodate the bandwidth.

For frequency doubling femtosecond pulses, if the pump bandwidth is significantly wider than the acceptance bandwidth, it is still possible to achieve high conversion efficiency. The pump frequencies outside of the acceptance bandwidth can still contribute to the conversion efficiency via sum frequency generation, essentially squeezing the broadband pump into a relatively narrower-band SHG pulse [1].

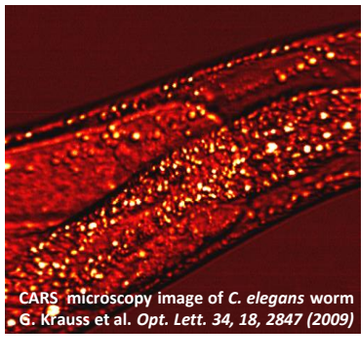
For femtosecond sources, using a 1mm crystal length and 5-10µm focussed spot sizes, customers have reported efficiencies of 40-60% for ~100fs, 100MHz and 100-200mW average powers. Due to the very wide temperature acceptance bandwidth, <1mm long crystals can be used at room temperature, and with no temperature controller, for SHG at 1550 or 1560nm.

Length (mm)	Pump acceptance bandwidth (nm)	Temperature acceptance bandwidth (°C)	Maximum SHG bandwidth (nm)	Input pulse duration*
0.3	40	265	20	<30 – 100 fs [2]
0.5	24	170	12	50 – 100 fs
1	12	90	6.0	100 – 200 fs
3	4.0	30	2.0	200 – 500 fs
5	2.4	20	1.2	0.5 – 2 ps
10	1.2	10	0.6	1 – 3 ps [3]

** Recommendation based on best SHG efficiency.*

Applications

- THz generation
- STED microscopy
- Metrology
- Frequency comb stabilization
- CARS microscopy



CARS microscopy image of *C. elegans* worm
G. Krauss et al. *Opt. Lett. 34, 18, 2847 (2009)*

1. K. Moutzouris et al., Optics letters, vol. 31, no. 8, pp. 1148–50, (2006)
2. C. W. Freudiger et al., Nature Photonics 8, 153–159 (2014)
3. C. Peuntinger et al., Phys. Rev. Lett. 113, 060502