Peridocally Poled Nonlinear Materials
(PP-MgO:LN, PP-MgO:SLT, PP-MgO:SLN, PPLN)

HCP provides custom designed PPXX chips and professional services concerning any particular process. We also welcome joint R&D for promising projects. **HCP** keeps moving forward to produce the highest quality and the most stable frequency converters to right meet customers' need.

Technology

Based on the quasi-phase-matching techniques, QPM, the nonlinear materials' structures are periodically inverted by electric field poling methods to form a well-defined domain patterns bulk device. The QPM technique basically allows two waves to compensate their phase velocity difference within a body of nonlinear crystal.
The two-phase velocity difference is compensated by shifting the phase relative to one another over a coherent distance through inverting the sign of the nonlinear coefficient, such that it allows an access to all elements of a crystal's nonlinear tensor within its entire transparency range.
The periodically poled of bulk non-linear materials are suitable for diverse applications such as optical frequency converter to generate the full spectrum of light source from visible to mid-IR, as high speed switching device for light modulation and as other innovative applications that are yet to be contemplated.
As differ to the birefringent phase matching, the QPM technique utilizes the whole transparency range (0.35 um ~ 5.0 um in case of lithium niobate) of the non-linear materials and their highest non-linear coefficient for efficient optical frequency conversion in OPO, SHG, SFG, DFG and OPG laser applications. Other a-periodic pattern designs such as cascaded, fan-out, and customized configuration are also available for applications using the CW, pulsed and ultra-short pulsed laser pumps.

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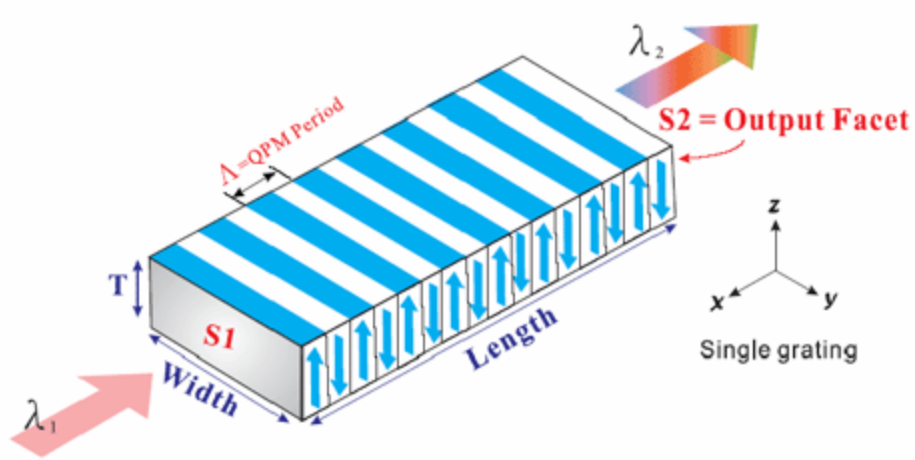
Non-linear Materials

Currently, several nonlinear materials are available using the periodically poled technique such as lithium niobate (PPLN), MgO doped lithium niobate (PP:MgO:LN), and MgO doped of stoichiometric lithium Tantalate (PP-MgO:SLT).
Both standard and customized QPM grating periods are available based on customers' specifications and requirements for the generation of visible and UV-blue light to near and mid-infrared.

Specifications



Material	Application	General Spec.
PP-MgO:CLN Bulk Chip (Periodically Poled 5 mol% MgO-doped Congruent Lithium Niobate)	• Free space full spectrum wavelength converters. • RGB laser generation • IR/Mid-IR laser generation • SHG/SFG/DFG/OPG/OPO/OPA, up- and down- conversion process • UV-band laser generation • 1st order or higher order wavelength conversion • Pulsed or high energy laser conversion process	• QPM period: 4~500 micron depending on materials • Dimension*: Length: up to 80 mm Width: up to 50 mm Thickness: 0.5/1/2/3 mm** • QPM Patterns: Single, Multiple, Fan-out, Cascade, Chirped (APLN) • Type I (e-e-e) & Type II phase matching • Duty cycle: ~ 50/50 • Input/Output Surface Polishing: Flat/Angle*** • Thin film coating: Anti-Reflection / High-Reflection
PP-MgO:SLN Bulk Chip (Periodically Poled 1.2 mol% MgO-doped Stoichiometric Lithium Niobate)		
PP-MgO:SLT Bulk Chip (Periodically Poled 1.0 mol% MgO-doped Stoichiometric Lithium Tantalate)		
PP:CLN Bulk Chip (Periodically Poled Congruent Lithium Niobate)		
Note: * Different dimensions including lengh, width and thickness are available upon request ** Thinner or thicker chips are available based on R&D contracts *** High quality, resonated cavity level polishing endfaces are also available upon request		

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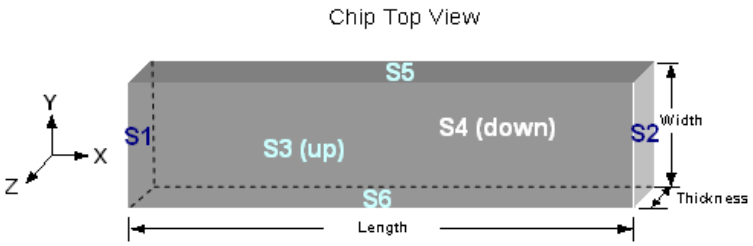
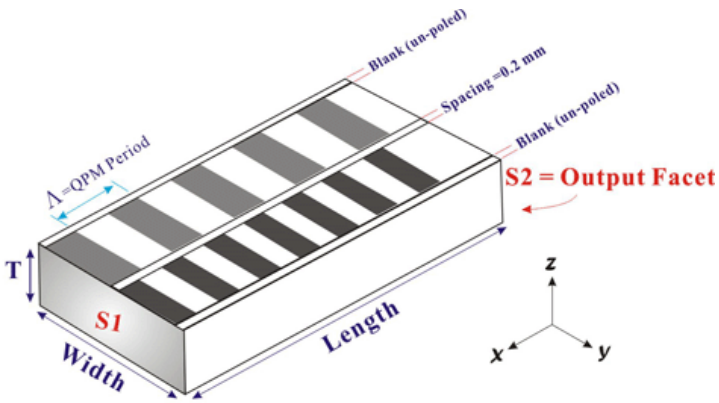
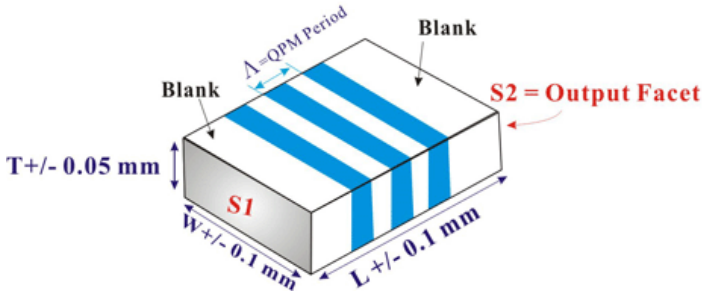
Property \ Material	$LiNbO_3$ (Lithium Niobate)	$LiTaO_3$ (Lithium Tantalate)
Transparency range (nm)	330-5500	280-5500
Refractive index	2.2	2.2
Nonlinearity	d21=-2.6pm/V	
	d31=-4.6pm/V	d31=0.85pm/V
	d33=25pm/V	d33=-13.8pm/V
Surface damage threshold for 10ns (J/cm2)	10	>> $LiNbO_3$
Phasematching Schemes	QPM、BPM	QPM、BPM
★ The above figures are based on wavelength at 1064nm and software "SNLO"		

Dimensions





Multiple gratings



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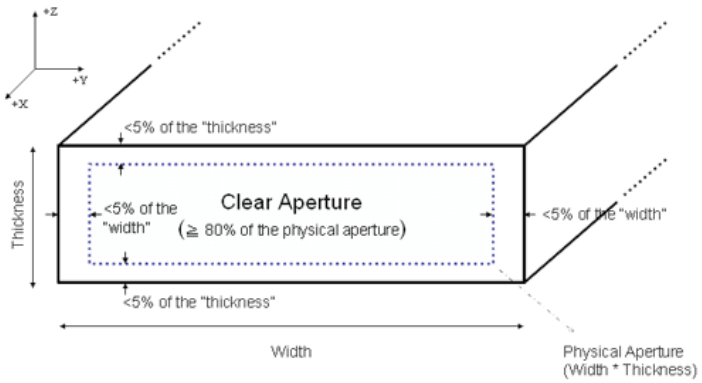
Mechanical Property

Property	Specification	Tolerance
Length	0.5≦L≦3 mm	+0.1/-0.1 mm
	3＜L≦80 mm	+0.2/-0.1 mm
Width	1~10 mm	± 0.1
Thickness	0.5/1/2/3	± 0.05
Chamfer in S1 and S2	< 0.1 mm	
Chamfer in S3, S4, S5 and S6	< 0.2 mm	

Material	Length	Thickness
PP-MgO:CLN	up to 80 mm	0.5/1/2/3 mm
PP-MgO:SLN	up to 50 mm	0.5/1/2 mm
PP-MgO:SLT	up to 30 mm	± 0.10.5/1/2 mm
PP:CLN	up to 50 mm	0.5/1 mm

Optical Property

Property	OPG (Single pass)	OPO (Cavity)
Minimum clear aperture S1 & S2	≧ 80% of the physical aperture	
Surface quality of S1 and S2 (scratch / dig)	20 / 10	10 / 5
Surface flatness of S1 and S2	λ/4 @ 633 nm	λ/6 @ 633 nm
Parallelism between S1 and S2	< 5'	< 3'
Perpendicularity between S1/S2 and S3/S4	< 10'	< 5'
AR/HR coating reflectivity on S1 and S2 for polarization parallel to the z axis	Depends on wavelengths Ex: DBAR coating for 1064 nm SHG R<0.5% at 1064 nm, R<1% at 532 nm	
AR coating optical damage threshold	>1,000 kW/cm^2	
* Standard polishing grade for length <5 mm is OPG		



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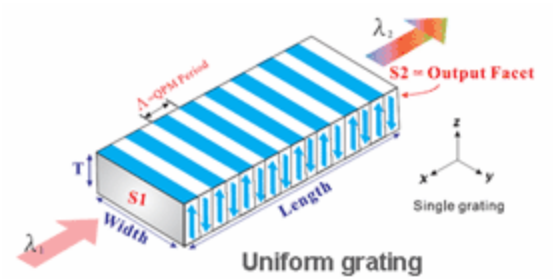
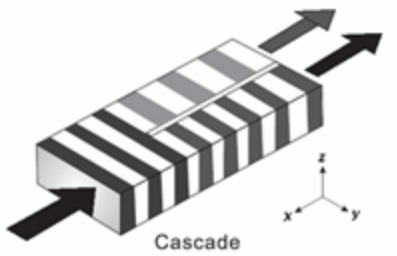
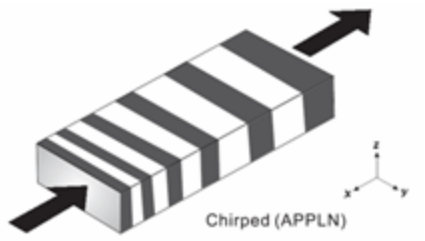
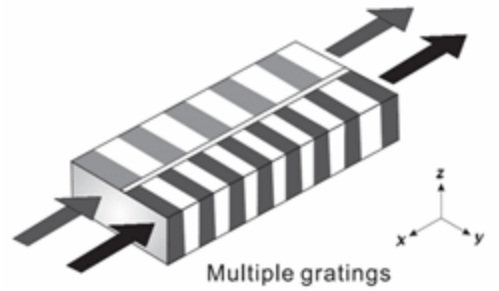
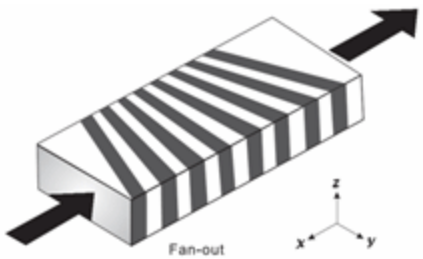
QPM Patterns











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