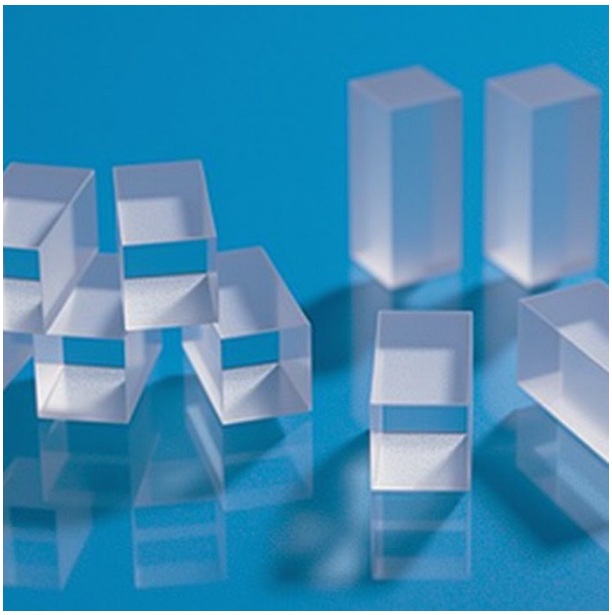
Photonics On Crystals

POC-OC-122411-MgO:LiNb03 Crystal Datasheet

1. Main Features

- High resistance to optical damage with enhanced photorefractive properties.
- Broad transparency range: 400 nm to 5000 nm, ideal for SHG and THG applications.
- Excellent nonlinear optical properties with high electro-optic coefficients.
- Stable performance at high power and high temperature, suitable for QPM applications.
- Non-hygroscopic, robust mechanical and chemical stability for long-term reliability.



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2. Material General Description

Magnesium-doped Lithium Niobate (MgO:$LiNbO_3$) crystal is a widely used nonlinear optical material with enhanced optical and thermal properties. The doping of MgO increases its resistance to photorefractive damage, making it ideal for high-power laser systems and frequency conversion applications. MgO:$LiNbO_3$ exhibits a broad transparency range from 400 nm to 5000 nm and maintains exceptional nonlinear optical and electro-optic coefficients. This crystal is a preferred choice for second-harmonic generation (SHG), third-harmonic generation (THG), and quasi-phase-matched (QPM) applications, such as periodically poled MgO:$LiNbO_3$ (PPMgO:LN) devices. Furthermore, its non-hygroscopic nature and excellent mechanical and chemical stability ensure consistent performance over extended usage periods, making it suitable for both scientific research and industrial applications.

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3. General Applications and Examples

MgO:$LiNbO_3$ crystals are versatile and widely used in the following applications:

1. **Frequency Doubling (SHG):**
    - $MgO:LiNbO_3$ is an ideal material for doubling the frequency of Nd:YAG and $Nd:YVO_4$ lasers, producing green light at 532 nm.
    - It is also effective for blue laser generation at 473 nm via SHG of 946 nm lasers.
2. **Optical Parametric Oscillators (OPOs):**
    - This material is extensively used in OPOs to generate tunable mid-infrared radiation for spectroscopy, imaging, and environmental sensing.
    - MgO doping ensures higher damage resistance and stable operation at high power levels.
3. **Quasi-Phase-Matched Devices (QPM):**
    - $PPMgO:LiNbO_3$ devices enhance wavelength conversion efficiency by leveraging periodic domain inversion.
    - Commonly applied in telecom, bio-imaging, and THz wave generation.
4. **Electro-Optic Modulators (EOMs):**
    - High electro-optic coefficients make $MgO:LiNbO_3$ suitable for Q-switches, Pockel cells, and phase modulators.
    - Frequently used in fiber optic systems and high-speed communication networks.
5. **Terahertz (THz) Wave Generation:**
    - $MgO:LiNbO_3$ is used for efficient THz generation, offering a wide bandwidth for imaging and spectroscopy applications.

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4. Chemical and Structural Properties

Table 1. Chemical and Structural Properties

Property	**Value**
Crystal Structure	Trigonal, Space Group R3c
Lattice Parameter	a = 5.149 Å, c = 13.863 Å
MgO Doping Concentration	5 mol%
Melting Point	1253°C
Density	4.64 g/cm³
Mohs Hardness	5
Thermal Expansion Coefficient	15 x 10^{-6} /°C
Thermal Conductivity	~38 W/(m·K) at 25°C

Resistivity	~10^{13} Ω·cm at 200°C

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5. Optical and Nonlinear Optical Properties

Table 2. Optical and Nonlinear Optical Properties

Property	**Value**
Transparency Range	400 nm – 5000 nm
Refractive Indices (1064 nm)	n_o = 2.286, n_e = 2.232
Electro-Optic Coefficients	r_{33} = 32 pm/V, r_{13} = 8.6 pm/V
NLO Coefficients	d_{31} = 6.0 pm/V, d_{33} = 25 pm/V
Effective NLO Coefficient	$d_e ff = d_{33} \cos\theta \cos^2\varphi \cos 3\phi$
Damage Threshold	150 MW/cm² (10 ns, 1064 nm)

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6. Spectrum Transmission Curves

$MgO:LiNbO_3$ provides broad transmission from UV to mid-IR (400 nm – 5000 nm), supporting versatile laser systems for SHG, OPO, and THG applications.

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7. Coating Specification

- **AR Coatings:**
  - Available for specific wavelengths (e.g., 532 nm, 1064 nm).
  - Dual-band AR coating ensures low reflectance (<0.2% @ 1064 nm and <0.5% @ 532 nm).
- **Custom Coatings:**
  - Gold or chrome plating for enhanced durability.
  - Custom anti-reflective or highly reflective coatings available upon request.

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8. Standard Fabrication Specifications

Table 3. Standard Fabrication Specifications

Property	**Specification**
Dimension Tolerance	(W ± 0.1 mm) x (H ± 0.1 mm) x (L ± 0.2 mm)
Angle Tolerance	$\Delta\theta \leq 0.25°$, $\Delta\phi \leq 0.25°$
Parallelism	< 20 arc seconds

Perpendicularity	< 5 arc minutes
Surface Quality (Scratch/Dig)	10/5
Surface Flatness	λ/8 @ 633 nm
Wavefront Distortion	λ/8 @ 633 nm
Damage Threshold	> 150 MW/cm² @ 1064 nm

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9. POC Strength and Capabilities

- Precision quality control for high-power laser systems.
- Dedicated production capacity for custom PPMgO:$LiNbO_3$ devices.
- Robust R&D support for advanced photonics applications.
- Fast lead times with global shipping support.

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10. Standard Products

Table 4. Standard Products

Product Code	Dimensions (mm)	Coating Type	Application	Price (USD)
MgO-LN-01	10 x 10 x 1	AR @ 1064/532 nm	SHG, OPO	$180
MgO-LN-02	15 x 15 x 2	DBAR @ 1064/532 nm	Electro-Optic Modulation	$250
MgO-LN-Custom	Custom Dimensions	Custom Coatings	Tailored Applications	On Request