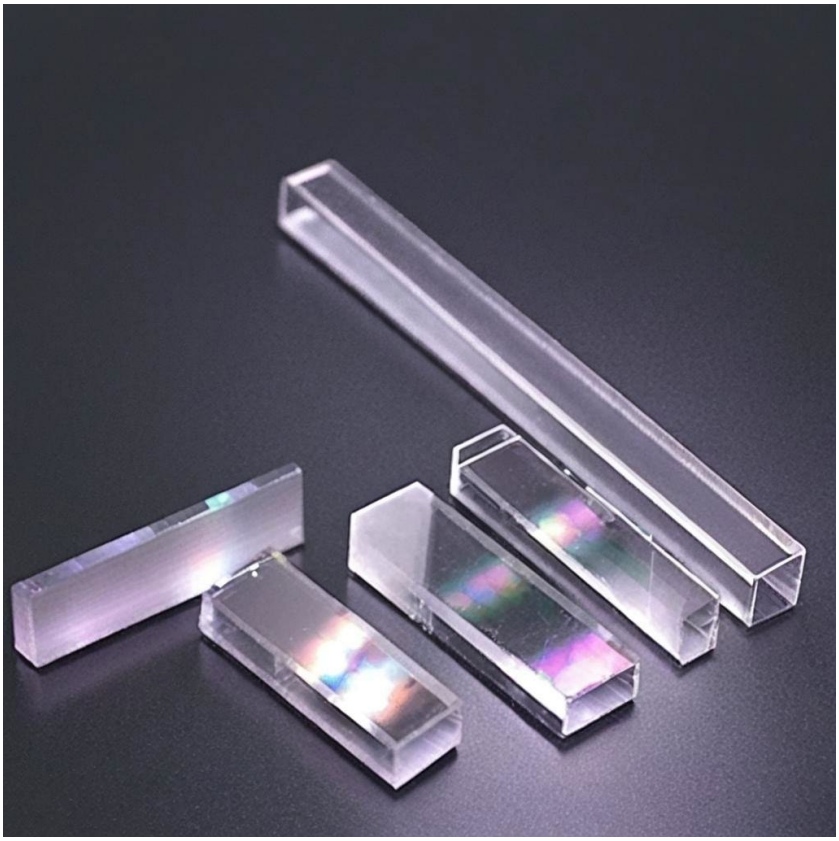
Photonics On Crystals

POC-OC-122423-PPLN Crystal Datasheet

1 Main Features

- **Wide Transparency Range:** Covers a broad range from 0.4 µm to 4.5 µm, suitable for diverse applications.
- **High Nonlinear Efficiency:** Optimized for quasi-phase-matching (QPM) processes with precision fabrication.
- **Customizable Poling Periods:** Supports temperature-controlled QPM applications for enhanced wavelength flexibility.
- **Long Operational Lifespan:** Durable material ideal for high-power and long-term applications.
- **Broad Application Range:** Effective for optical parametric oscillation (OPO), second-harmonic generation (SHG), and sum-frequency generation (SFG).



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2. Material General Description

Periodically Poled Lithium Niobate (PPLN) is a highly efficient nonlinear crystal designed for wavelength conversion processes. Its wide transparency range (0.4–4.5 µm) and high damage

threshold make it suitable for demanding photonic applications. PPLN is fabricated with precision-controlled periodic domains, enabling quasi-phase matching (QPM) for nonlinear optical processes such as second-harmonic generation (SHG), sum-frequency generation (SFG), and optical parametric oscillation (OPO).

The use of PPLN in OPO applications facilitates wavelength tuning from 3 µm to 4.5 µm, providing exceptional efficiency and output power. With proper temperature control, PPLN crystals enable high-accuracy wavelength tuning and consistent performance, making them a popular choice in fields like quantum optics, spectroscopy, and medical imaging.

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3. General Applications and Examples

PPLN crystals are widely utilized in nonlinear optics due to their broad transparency range and efficient phase-matching properties. Key applications include:

1. **Second-Harmonic Generation (SHG):**
    - Converts infrared laser light into visible or near-infrared wavelengths with high efficiency.
    - Example: PPLN is used in green laser systems for spectroscopy and biomedical imaging.
2. **Optical Parametric Oscillation (OPO):**
    - Generates mid-infrared wavelengths (3 µm–4.5 µm) using a pump source at 1064 nm.
    - Example: Mid-infrared OPO systems based on PPLN are used in gas sensing and environmental monitoring.
3. **Difference Frequency Generation (DFG):**
    - Combines 1064 nm and 775 nm pump sources to generate output in the 2400–3000 nm range.
    - Example: PPLN-based DFG is employed in advanced spectroscopy systems.
4. **Sum-Frequency Generation (SFG):**
    - Combines 1550 nm and other wavelengths (e.g., 780 nm or 810 nm) to generate green laser light.
    - Example: SFG processes in PPLN crystals are used in biomedical imaging and optical coherence tomography (OCT).

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4. Chemical and Structural Properties

Property	Value
Chemical Formula	LiNbO3

Crystal Structure	Trigonal
Transparency Range	0.4 µm–4.5 µm
Nonlinear Coefficient	d33 = 27 pm/V
Damage Threshold	> 500 MW/cm² (at 1064 nm)
Poling Period	4–200 µm (standard and custom)
Refractive Index (1064 nm)	n_o = 2.23, n_e = 2.14
Thermal Conductivity	~4.74 W/m·K

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5. Optical and Nonlinear Optical Properties

Property	**Value**
Nonlinear Process	Quasi-Phase Matching (QPM)
Conversion Efficiency	Up to 50%
Phase Matching Type	Type I and Type II
Coherence Length	~30 µm
Effective Nonlinear Coefficient (deff)	16 pm/V (QPM-enhanced)

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6. Spectrum Transmission Curves

The spectrum transmission range of PPLN crystals extends from 0.4 µm to 4.5 µm. This broad range enables compatibility with mid-IR and visible wavelength applications. Below is an approximation of transmission data derived from standard measurements:

- **Transmission Efficiency**: >90% within the range of 0.5 µm to 4.2 µm.
- **Spectral Loss**: Negligible in the 3–4 µm mid-IR range, with high consistency across wavelengths.

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7. Coating Specifications

Coating Type	**Specifications**
Anti-Reflective (AR) Coating	R < 0.2% for specified wavelengths
Custom Coatings	Available upon request

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8. Standard Fabrication Specifications

Specification	**Value**

Dimensions	0.5 × 5 × 20 mm (typical)
Poling Period	6.8 µm (standard), customizable
Surface Flatness	Lambda/6 @ 632.8 nm
Parallelism	< 10 arc seconds
Perpendicularity	< 10 arc minutes
Surface Quality	10-5 Scratch-Dig

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9. POC Strength and Capabilities

Photonics On Crystals (POC) is a leading supplier of high-quality nonlinear optical crystals, specializing in PPLN crystals for advanced photonics applications. With state-of-the-art manufacturing facilities and extensive expertise in material science, POC offers tailored solutions for quantum optics, spectroscopy, and industrial laser systems. Our commitment to quality ensures every product meets the highest standards of precision and performance.

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10. Standard Products

Product Code	Dimensions (mm)	Poling Period (µm)	Price (USD)
PPLN-01	0.5 × 5 × 20	6.8	500
PPLN-02	1 × 10 × 40	4.5	750
Custom-PPLN	Customizable	Customizable	Request Quote