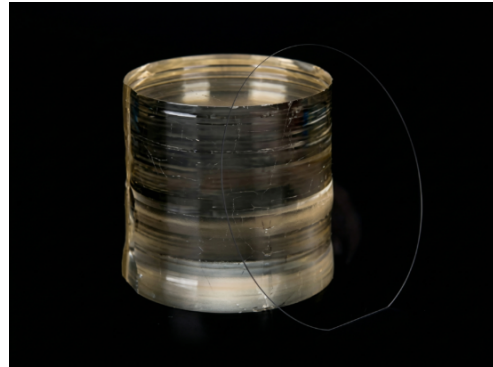


## CRYSTAL WAFERS &amp; SUBSTRATES

# LiNbO<sub>3</sub> Optical Wafers

## Product Brochure &amp; Technical Reference

Lithium niobate wafers for electro-optic, photonic, nonlinear-optical and acoustic-device projects. Material grade, orientation and wafer surface requirements should be defined together.



Reference product image. Shown geometry is illustrative.

## Material reference properties / options

| Property              | Typical Value                                                                                                                                                                                                          |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Growth method         | Czochralski method                                                                                                                                                                                                     |
| Crystal structure     | Trigonal, point group 3m                                                                                                                                                                                               |
| Lattice constant      | a = b = 5.148 Å, c = 13.863 Å                                                                                                                                                                                          |
| Melting point         | Approx. 1250 C                                                                                                                                                                                                         |
| Density               | Approx. 4.64 g/cm <sup>3</sup>                                                                                                                                                                                         |
| Mohs hardness         | Approx. 5                                                                                                                                                                                                              |
| Refractive index      | n <sub>o</sub> = 2.286, n <sub>e</sub> = 2.203 at 632.8 nm                                                                                                                                                             |
| Nonlinear coefficient | Supplier-reported values include d <sub>33</sub> around 34.45 pm/V, d <sub>31</sub> and d <sub>15</sub> around 5.95 pm/V, d <sub>22</sub> around 13.07 pm/V; confirm convention and wavelength for final specification |

Reference values and options for selection. Confirm the material grade, geometry, test conditions and acceptance criteria for the quoted configuration.

## CRYSTAL WAFERS &amp; SUBSTRATES

# Configuration & quotation

Define the component around your application

Application examples: Electro-optic modulators, phase modulators and optical switches; PPLN waveguides, nonlinear optics, SHG, OPO and frequency conversion; Integrated photonics and thin-film lithium niobate process development

## Available LiNbO<sub>3</sub> Wafer Options

| Item           | Available Option                                                                                                                 | Design Notes                                                                                                            |
|----------------|----------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Diameter       | 2 inch, 3 inch, 4 inch                                                                                                           | Availability depends on material grade, orientation, thickness and quantity.                                            |
| Orientation    | X-cut, Y-cut, Z-cut, Y-135 and custom cuts                                                                                       | Orientation should match electro-optic, SAW, waveguide or nonlinear-optic design requirements.                          |
| Thickness      | 0.18 mm and above; common values include 0.25 mm, 0.5 mm and 1.0 mm                                                              | Thickness tolerance and TTV should be confirmed with wafer diameter and polish type.                                    |
| Surface type   | SSP, DSP, DSL                                                                                                                    | Single-side polished, double-side polished or double-side lapped processing.                                            |
| Material grade | CLN, SLN, MgO:LiNbO <sub>3</sub> , Fe:LiNbO <sub>3</sub> , Er:LiNbO <sub>3</sub> , Tm:LiNbO <sub>3</sub> , Pr:LiNbO <sub>3</sub> | Doping and stoichiometry should be selected according to optical damage, photonics, nonlinear or research requirements. |
| Product form   | Wafers, boules, blanks and customized optics                                                                                     | Custom shapes and optical components can be reviewed case by case.                                                      |

## Available LiNbO<sub>3</sub> Material Grades

| Material               | Grade   | Diameter               | Growth / Cut Direction         | Typical Use                                                                                        |
|------------------------|---------|------------------------|--------------------------------|----------------------------------------------------------------------------------------------------|
| LiNbO <sub>3</sub>     | Optical | 2 inch, 3 inch, 4 inch | X, Y, Z, Y-135 and custom cuts | Electro-optic, photonic, nonlinear, SAW and waveguide substrates                                   |
| MgO:LiNbO <sub>3</sub> | Optical | 2 inch, 3 inch         | X or Z                         | High-power optical and nonlinear applications requiring improved photorefractive-damage resistance |
| Fe:LiNbO <sub>3</sub>  | Optical | 2 inch, 3 inch         | Z                              | Photorefractive and holographic research applications                                              |
| Tm:LiNbO <sub>3</sub>  | Optical | 2 inch, 3 inch         | Z                              | Special optical and research applications                                                          |
| Pr:LiNbO <sub>3</sub>  | Optical | 2 inch, 3 inch         | Z                              | Special optical and research applications                                                          |
| Er:LiNbO <sub>3</sub>  | Optical | 2 inch, 3 inch         | X or Z                         | Active photonic and research substrates depending on device design                                 |

## Product Parameters of Optical Grade Lithium Niobate Wafers

| Parameter                     | Typical Value / Option                                                                                                                                               |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Material                      | LiNbO3 single crystal                                                                                                                                                |
| Curie temperature             | Approx. 1142 °C; actual value may vary slightly with composition and material grade                                                                                  |
| Cutting angle                 | X-cut, Y-cut, Z-cut, Y-135 and custom cuts                                                                                                                           |
| Orientation tolerance         | Typically $\pm 15$ arcmin, or tighter by review                                                                                                                      |
| Diameter                      | 2 inch, 3 inch and 4 inch                                                                                                                                            |
| Diameter tolerance            | Typically $\pm 0.20$ mm                                                                                                                                              |
| Thickness                     | 0.18 mm and above; custom thickness available                                                                                                                        |
| Thickness tolerance           | Typically $\pm 0.025$ mm, depending on wafer diameter and thickness                                                                                                  |
| Primary flat length           | 16 mm, 22 mm, 32 mm or custom flat according to wafer specification                                                                                                  |
| TTV                           | Typically $\leq 5$ $\mu\text{m}$ ; tighter limits may be available depending on wafer diameter, thickness, polishing type and grade                                  |
| Bow                           | Maximum bow to be agreed according to wafer diameter, thickness and measurement method                                                                               |
| Warp                          | Maximum warp to be agreed according to wafer diameter, thickness and measurement method                                                                              |
| Orientation flat              | According to the agreed wafer specification or customer drawing                                                                                                      |
| Surface type                  | Single-side polished, double-side polished or double-side lapped                                                                                                     |
| Polished side Ra              | Typically $< 0.5$ nm, subject to wafer grade and measurement method                                                                                                  |
| Polished side surface quality | Typically S/D 20/10, or according to the agreed specification                                                                                                        |
| Lapped side Ra                | Typically $0.2\text{--}0.5$ $\mu\text{m}$ , or customized                                                                                                            |
| Edge criteria                 | Edge profile, flat geometry and allowable edge chipping can be specified according to the customer drawing or applicable IEC 62276 requirements for SAW-grade wafers |
| Quality                       | Free of cracks; bubbles and inclusions controlled according to agreed inspection criteria                                                                            |
| Optical doping                | Er, Fe, MgO, Tm, Pr or other doped options by review                                                                                                                 |
| Refractive index              | Typical $n_o \approx 2.286$ and $n_e \approx 2.203$ at 632.8 nm; values depend on wavelength, temperature, composition and material grade                            |
| Wafer surface contamination   | No visible non-removable stains under the agreed inspection method                                                                                                   |

| Parameter            | Typical Value / Option                                                                                                                  |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Particles            | Particle limits, minimum particle size, inspection area and measurement method to be agreed before production                           |
| Scratch and chipping | No cracks; scratches and edge chips controlled according to the agreed visual inspection and acceptance criteria                        |
| Defects              | No cracks, saw marks or non-removable stains; inclusions, scratches and edge defects controlled according to agreed inspection criteria |
| Packaging            | Typically 25 pcs per wafer box, or custom protective packing on request                                                                 |

## Prepare your quotation

| RFQ Item            | Information to Provide                                                                                                                                          |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Application         | EO modulator, PPLN, photonics, SAW device, waveguide substrate, Q-switch, sensor or custom optical component.                                                   |
| Material and grade  | CLN, SLN, MgO:LiNbO <sub>3</sub> , Fe:LiNbO <sub>3</sub> , Er:LiNbO <sub>3</sub> , Tm:LiNbO <sub>3</sub> , Pr:LiNbO <sub>3</sub> or other material requirement. |
| Orientation         | X-cut, Y-cut, Z-cut, Y-135, rotated cut, orientation tolerance, primary flat direction and flat length.                                                         |
| Wafer geometry      | Diameter, thickness, thickness tolerance, TTV, bow, warp, bevel and edge criteria.                                                                              |
| Surface requirement | SSP, DSP or DSL; Ra, scratch-dig, particle limit, contamination limit and visual defect criteria.                                                               |
| Order information   | Quantity, wafer box requirement, inspection report requirement, packaging, delivery schedule and drawing.                                                       |

Reference values and options for selection. Confirm the material grade, geometry, test conditions and acceptance criteria for the quoted configuration.

### Send drawings for engineering review

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