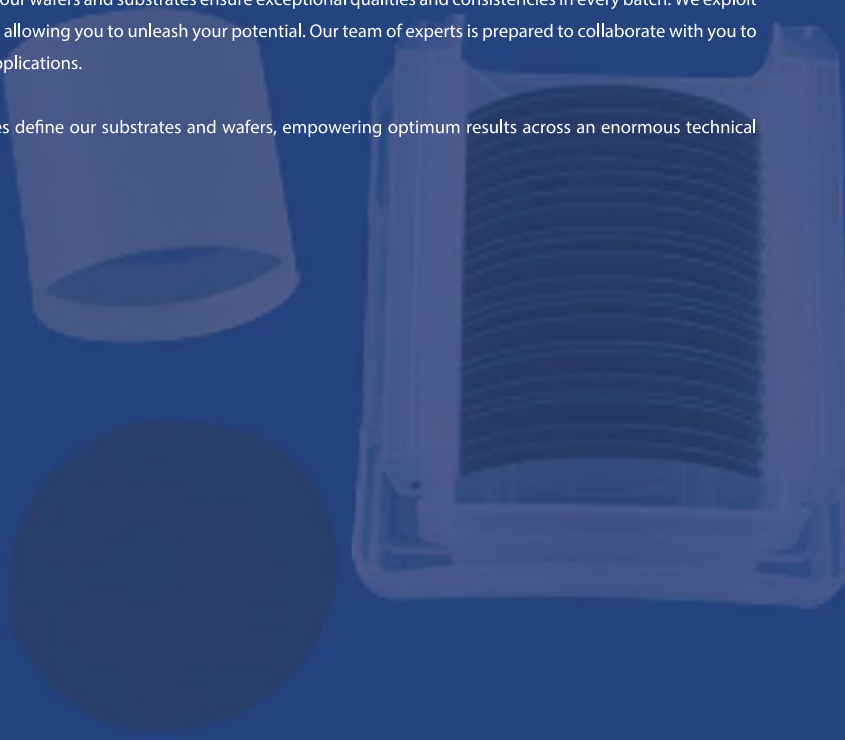
+04 Wafers and Substrates

Wafers and Substrates

Shalom EO offers a diverse catalog of standard and custom wafers and substrates oriented to meet the stringent demands of various applications. Our comprehensive range includes a wide selection of substrate and wafer materials:

Sapphire(Al_2O_3), LSAT, CZT, $LiNbO_3$, $LiTaO_3$, Langasite, GaSb, GaAs, MgO, GGG, Ge, STO, YSZ, TiO_2, BeO/SiC ceramics, etc. Categorized into SAW Wafers, $LiNbO_3$/$LiNbO_3$/Quartz Ultra Thin Films and Wafers, Optical Grade $LiNbO_3$/$LiTaO_3$ Crystal Wafers, Substrates and Wafers for Epitaxial Thin Film Growth, Glass Wafers, and Ceramic Wafers. Crafted from the finest materials with precision engineering, our wafers and substrates ensure exceptional qualities and consistencies in every batch. We exploit various substrate materials, crystal orientations, and surface finishes, allowing you to unleash your potential. Our team of experts is prepared to collaborate with you to develop custom wafers and substrates optimized for your unique applications.

At Shalom EO, precision engineering and uncompromising qualities define our substrates and wafers, empowering optimum results across an enormous technical domain.



Wafers and Substrates

Sapphire (Al2O3) Substrates and Wafers

- Excellent mechanical and thermal robustness, anti-chemical corrosion, electrical insulation
- Maximum diameter: 6 inches, circular/square and custom shapes available
- Class 1000 clean room production and class 100 box/bag package
- Standard or Custom
- Orientations: C-Cut, A-Cut, R-Cut, M-Cut, or Custom
- Ideal for epitaxial thin film growth of various materials: III-V and II-VI compound semiconductors (Blue/White/Violet LEDs), Microelectronic IC applications (Silicon on Sapphire Integrated Circuit, SOS), Hybrid Microelectronics (HIC/MCM), ferromagnetic/ferroelectric thin film growth

Sapphire is an excellent substrate material for the epitaxial growth of various thin films. Sapphire has exceptional high-temperature resistance, chemical corrosion resistance, electrical insulation, wide optical transmission, unrivaled mechanical hardness, and wear resistance. The molecular bonding of sapphire is strong, enabling the production of thinner pieces without fracture.

Sapphire Wafers and Substrates are versatile, their uses include but are not limited to III-V and II-VI compound thin film growth for semiconductors, Light Emitting Diodes(LEDs), Y-series, La-series high-temperature superconducting (HTSC) thin films, Microelectronic IC (Silicon on Sapphire Integrated Circuit, SOS), Hybrid Microelectronic applications, and ferromagnetic/ferroelectric thin film growth.

Hangzhou Shalom EO offers off-the-shelf and custom sapphire substrates and wafers, the standard versions have a c-plane orientation, while other orientations including a-plane, r-plane, and m-plane are also available. The maximum diameter is 6 inches, and substrates could either be single-side polished or double-side polished. In addition to the standard circular shapes, other shapes like square and rectangular are also accessible. Shalom EO has eminent capabilities and endeavors to produce high-precision sapphire wafers. We select single crystal sapphire with superior sapphire purities to fabricate the wafers and substrates. A series of advanced equipment is utilized to manufacture our products in a class 1000 clean room. Before shipment, we conduct XRD diffraction analysis and use Atomic Force Microscope (AFM) to inspect the product to ensure optimum surface qualities of the product.

Specifications:

Materials	Al2O3 crystals or sapphire	Orientation Error	±0.5deg.
Orientation	A-plane	<11-20>	2.379Å
	R-plane	<1-102>	1.740Å
	M-plane	<10-10>	1.375Å
	C-plane	<0001>	2.165Å
Maximum Diameter	6 inches	Surface Finish	SSP (single surface polished) or DSP (double surface polished)

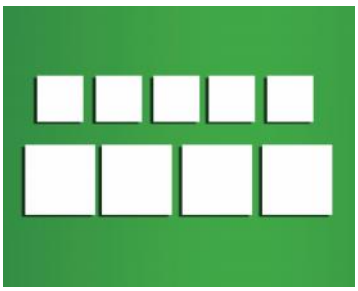
Basic Properties:

Crystal Structure	Hexagonal	Unit Cell Constant	a=4.748Å c=12.97Å
Melt Point（℃）	2040℃	Crystal Purity	99.99%
Density	3.98 （g/cm3）	Hardness	9 （mohs）
Thermal Expansion（/℃）	7.5 x10-6	Dielectric Constants	~ 9.4 @300K at A axis ~ 11.58@ 300K at C axis
Thermal Conductivity（Calorie/℃ Cm.S）		⊥ c	//c
	23℃	0.055	26℃ 0.060
	77℃	0.040	70℃ 0.041

Product List :

Code	Size	Thickness	Orientation	Surface Finish	Unit Price
6505-001	10x10mm	0.5mm	C-plane	SSP	Inquire
6505-002	10x10mm	0.5mm	C-plane	DSP	Inquire
6505-003	Φ12.7mm	0.5mm	C-plane	SSP	Inquire
6505-004	Φ12.7mm	0.5mm	C-plane	DSP	Inquire
6505-005	Φ25.4mm	0.5mm	C-plane	SSP	Inquire
6505-006	Φ25.4mm	0.5mm	C-plane	DSP	Inquire
6505-007	φ50.8mm	0.43mm	C-plane	SSP	Inquire
6505-008	φ50.8mm	0.4mm	C-plane	DSP	Inquire
6505-009	φ100mm	0.65mm	C-plane	SSP	Inquire
6505-010	φ100mm	0.5mm	C-plane	DSP	Inquire
6505-011	φ150mm	1.0mm	C-plane	SSP	Inquire
6505-012	φ150mm	1.0mm	C-plane	DSP	Inquire

Bare Beryllium Oxide（BeO）Ceramic Substrates



- Outstanding Thermal Inductance, Maximum 280W/m.k
- Substantial Puncture Strength and High Electrical Resistance
- low loss at high frequencies, low dielectric constants
- Hot-press techniques
- Various custom shapes, specifications
- Applications: TEC, HIC, PCB, high-power, large-scale integrated circuits, electrical packages, aerospace, telecommunications, satellites

Hangzhou Shalom EO offers Bare Beryllium Oxide Ceramic Substrates of various custom shapes and specifications, and special structures such as holes, manufactured using hot-press techniques, which allows us to obtain quick turnaround at competitive prices. Our Beryllium Oxide ceramic substrates feature high BeO purities and unrivaled thermal inductance, with the maximum reaching 280W/m.K. The uncoated bare substrates are appropriate for further thick film treatment to produce PCB substrates and for diverse applications like high-power, large-scale integrated circuits, electrical packages, TEC, HIC, PCB, aerospace, telecommunications, satellites, etc. Besides, we also offer metalized versions of BeO ceramic substrates.

Application Notes:

It's worth noting that although Beryllium Oxide ceramics have been notorious for being deemed to be toxic, it's the soluble BeO power that's toxic. Beryllium Oxide ceramics, however, having gone through high-temperature processing, are insoluble in common acids and alkalis, therefore are not as detrimental as believed under proper protection measures. Shalom EO's Beryllium Oxide ceramic substrates are all produced and tested in compliance with pertinent regulations.

Specifications:

Note: Shalom EO offers substrates made from two different models (BEO99 and BEO99.5) of BeO Ceramics. The specifications of the two models are separately listed in the table below.

Parameters/Models		BEO99	BEO99.5
Volume Density		≥2.85g/cm3	≥2.88g/cm3
Flexural Strength		≥200Mpa	≥200Mpa
Average Coefficient of Expansion (at 25-500°C)		7.0-8.0x10-6/K	7.0-8.0x10-6/K
Thermal Conductivity	at 25°C	≥260W/m.K	≥285W/m.K
	at 100°C	≥190W/m.K	200W/m.K
Dielectric Constants	at 1MHz	6.7±0.2	
	at 10GHz	6.9±0.2	6.8±0.2
Dielectric Loss Tangent	at 1MHz	≤4x10-4	≤4x10-4
	at 10±0.5GHz	≤6x10-4	≤4x10-4
Volume Resistivity		≥1014 Ω.cm (at 20 °C)	≥1014 Ω.cm (at 100 °C)
Puncture Strength		≥30kV/mm	≥40kV/mm
Thermal Shock Resistance		Excellent	Excellent
Chemical Stability	1:9 HCL	≤0.1mg/cm2	≤0.1mg/cm2
	10% NaOH	≤0.1mg/cm2	≤0.1mg/cm2
Air Tightness		≤5x10-12Pa.m3/s	≤5x10-12Pa.m3/s
Average Grain Size		10-20μm	10-20μm

Thick Flim Metalized Beryllium Oxide（BeO) Ceramic Substrates

- Outstanding Thermal Inductance, dimensional tolerances <0.02mm
- Thick-Film Metalization Techniques
- Metal Coating: WMn, MoMn plus activators, additional nickel plating
- Custom shapes, specifications, circuit patterns
- Applications: high-power and large-scale integrated circuits, PCB, TEC, HIC, aerospace, hermetic electrical packages, satellites

Thick Film Metalized ceramic substrates, are ceramic substrates screened with conductor, resistor, resistor metal pastes, and fired. Beryllium Oxide (Beryllia/BeO) Ceramics are a kind of high-performance fine ceramic material with unparalleled thermal induction properties. Shalom EO's Thick Film Metalized BeO Ceramic Substrates are manufactured using thick-film WMn/MoMn metallization with nickel electroplating, delivering great bonding force, high weldabilities, and excellent tensile strength (>20MPA). Our thick film metalized ceramic substrates feature high ruggedness and minimized possibilities of outgassing, with the additional assurance that the nickel platings do not blister.

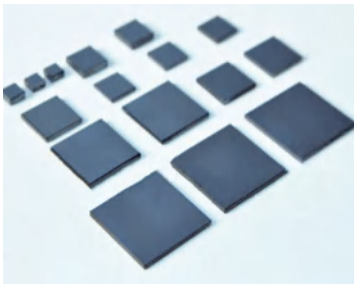
For the circuit-pattern-distributed versions, Shalom EO is capable of retaining the dimensional tolerances of the lines within 0.02mm. High-precision laser-cut ceramic substrates are also available in Shalom EO, where tight geometric monitoring could be realized through a series of laser-processing techniques, including laser-cutting, laser-drilling, laser-marking, etc. Our Thick Film Metalized Beryllium Oxide ceramic substrates are excellent platforms for wire bonding, ideal preforms of microwave PCBs, TEC for lasers, HIC for automotive, high-power semiconductor modules, and hermetic electrical packaging.

Specifications:

Note: Shalom EO offers substrates made from two different models (BEO99 and BEO99.5) of BeO Ceramics. The specifications of the two models are separately listed in the table below.

Parameters/Models		BEO99	BEO99.5
Volume Density		≥2.85g/cm3	≥2.88g/cm3
Flexural Strength		≥200Mpa	≥200Mpa
Average Coefficient of Expansion (at 25-500°C)		7.0-8.0x10-6/K	7.0-8.0x10-6/K
Thermal Conductivity	at 25°C	≥260W/m.K	≥285W/m.K
	at 100°C	≥190W/m.K	200W/m.K
Dielectric Constants	at 1MHz	6.7±0.2	
	at 10GHz	6.9±0.2	6.8±0.2
Dielectric Loss Tangent	at 1MHz	≤4x10-4	≤4x10-4
	at 10±0.5GHz	≤6x10-4	≤4x10-4
Volume Resistivity		≥1014 Ω.cm (at 20 °C)	≥1014 Ω.cm (at 100 °C)
Puncture Strength		≥30kV/mm	≥40kV/mm
Thermal Shock Resistance		Excellent	Excellent
Chemical Stability	1:9 HCL	≤0.1mg/cm2	≤0.1mg/cm2
	10% NaOH	≤0.1mg/cm2	≤0.1mg/cm2
Air Tightness		≤5x10-12Pa.m3/s	≤5x10-12Pa.m3/s
Average Grain Size		10-20μm	10-20μm

CdZnTe (CZT) Wafers and Substrates



- Excellent electrical properties, low dark current, and superior thermal stabilities
- For epitaxial growth of HgCdTe (MCT)
- Cutting-edge choice for IR detectors (IR Transmission≥60%)
- Room temperature operation
- Surface Roughness(Ra)≤0.5nm
- Application fields: semiconductor radiation detectors, photorefractive gratings, electro-optic modulators, solar cells, and terahertz generation

Cadmium Zinc Telluride (CZT /CdZnTe) Substrate, is a compound of cadmium, zinc, and tellurium with excellent electrical properties, low dark current, and superior thermal stabilities.

Due to its similar lattice constant to HgCdTe (MCT), the CdZnTe (CZT) substrate is a traditional option for HgCdTe (MCT) epitaxial thin film growth. And owing to the MCT epitaxial thin film's transmittance to infrared (IR) wavelengths, despite the difficulties in growing a large area of affordable high-quality substrates, CZT wafers remain the best choice for infrared detectors, photorefractive gratings, electro-optic modulators, solar cells, and terahertz generators.

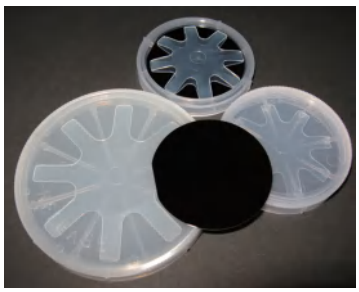
As a direct bandgap semiconductor with high atomic numbers, infrared devices based on CZT substrates continue to be the cutting-edge choices in the market in terms of sensitivities and being reliable. CZT substrates offer effective conversion of photons to electrons with high resolutions as a media of radiation detection, facilitating various tasks including medical imaging, scientific research, and industrial inspection. Also, radiation detectors using CZT can operate in direct-conversion (or photoconductive) mode at room temperature. The low dark current makes CZT substrates advantageous in conditions where light is insufficient, and the thermal stabilities render them suitable for high-temperature environments.

Hangzhou Shalom EO offers custom CZT substrates and wafers according to the customer's request, with a fine surface roughness of ≤0.5nm, packaged in class 1000 clean room vacuum packaging.

Specifications:

Materials	Cd1-xZnxTe，x=0.04	Type	p-type
Size(mm3)	14×14×1.3, 10×10×1	Index of Crystal Face	(111), (211)
Orientation and Accuracy	Low index surface orientation, Orientation Accuracy ≤0.3°	Resistivity	ρ ＞ 106 Ω·cm
IR Transmission%	≥60%	Infrared Imaging	Te inclusions≤ 2μm or Cd inclusions≤2μm
X-ray DCRC FWHM(FWHM)	≤30 rad·s	Average Etch Pit density(EPD)	1x104/cm2 ~ 5x104/cm2
Surfaces Roughness	Ra≤0.5 nm	Packaging	1000 class clean room, vacuum packaging
Storage Temperature	22 ℃ ~ 25 ℃	Storage Humidity	45% ~ 60%

Gallium Arsenide (GaAs) Crystals and Wafers



- Zinc blende crystal lattice structure and electron mobility 5 to 6 times greater than silicon
- Good performance under high frequency, high and low temperature, low noise, and high radiation tolerance
- Surface Roughness: Ra < 0.5nm
- Clean package: class 1000 clean room and class 100 bags
- Applications: epitaxial growth of other III-V semiconductors, microwave frequency integrated circuits, monolithic microwave integrated circuits, infrared light-emitting diodes, laser diodes, solar cells and optical windows

Gallium Arsenide (GaAs) Crystal is a crystalline compound of the elements gallium and arsenic. It is a III-V direct bandgap semiconductor with a Zinc blende crystal structure.

The fundamental function of GaAs wafers is to be used as a substrate material for the epitaxial thin film growth of other III-V semiconductors including indium gallium arsenide, aluminum gallium arsenide, etc. This kind of substrate has good performance under high frequencies, high temperature and low temperature, low noise, high radiation tolerance, and higher electron mobility than silicon which makes them suitable for high-frequency applications like radio frequency (RF) and microwave devices. In addition, GaAs have a direct bandgap, enabling efficient emission and absorption of light, making it ideal for optoelectronic devices like high-density p-i-n detectors and laser diodes with robust silicon electronic integrated circuits.

Hangzhou Shalom EO offers custom GaAs crystals, wafers, and substrates, which are suitable for the application of epitaxial growth, microwave, IR LED, laser diodes, solar cells, and infrared optical windows.

Specifications:

Orientation	(100) 0°±0.5°, (100) 2°±0.5°off toward <111>A, (100)15°±0.5°off toward <111>A	Size(mm)	25×25×0.3, 10×10×0.35, 10×5×0.35, 5×5×0.35
Polishing	SSP (single surface polished) or DSP (double surface polished)	Surface Roughness	≤5Å

Basic Properties:

Growth Method	VGF/ HB	Crystal Structure	Zinc Blende
Appearance	Very dark red, vitreous crystals	Density	5.3176 g/cm3
Lattice Constant	5.65×10-10m	Molar Mass	144.645 g•mol-1
Band Gap@300 K	1.424eV	Electron Mobility @300K	8500 cm2/(V×s)
Thermal Conductivity@300K	0.55 W/(cm×K)	Chemical Stability	Insoluble in water, ethanol, methanol, and acetone. Soluble in HCl.
Refractive Index	3.3	Packaging	class 1000 clean room vacuum packaging

Single Crystal	Doping	Conduction Type	Carrier Concentration	Dislocation Density
GaAs	Si	No	>5×1017 cm-3	<5×105 cm-2

Gallium Nitride (GaN) Crystals and Wafers

- Wide direct band gap, strong atomic bonds, and High thermal capacity/conductivity
- Stable physical and chemical properties
- Excellent optoelectronic properties in the short wavelength range
- Typical orientation of GaN wafers: C-Axis or <0001>
- Applications: blue, green, and UV-light LED, blue and UV light laser diodes (LD), high-power electronic devices, and high-frequency electronic devices

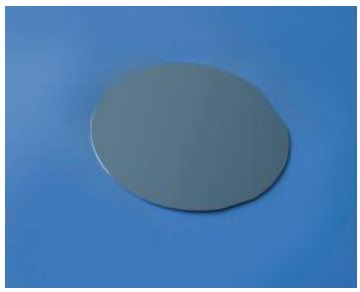
Gallium Nitride (GaN) is a semiconductor material with a wide direct bandgap (3.4 eV), strong atomic bonds (which contribute to its stable physical and chemical properties), exceptional thermal properties, and excellent radiation resistance. GaN (Gallium Nitride) crystals and wafers exhibit superior optoelectronic properties at short wavelengths, making them useful in LED applications (blue, green, UV-light) and ultraviolet detectors. GaN crystals and wafers are also suitable for manufacturing high-temperature semiconductor devices.

Hangzhou Shalom EO offers custom gallium nitride wafers and substrates according to customer's request, options including N-type and semi-insulating types of GaN wafers are available. Our gallium nitride crystals and wafers are widely used in various LEDs, blue light laser diodes ultra-violet (UV) laser diodes (LD), and electronic devices operating at high power and high frequencies.

Specifications:

Type	GaN-FS-10	GaN-FS-15
Size	10.0mm×10.5mm	14.0mm×15.0mm
Thickness	Rank 300, Rank 350, Rank 400	300 ± 25 μm, 350 ± 25 μm, 400 ± 25 μm
Orientation	C-axis(0001) ± 0.5°	
TTV	≤15 μm	
BOW	≤20 μm	
Carrier Concentration	>5x1017/cm3	/
Conduction Type	N-type	Semi-Insulating
Resistivity(@300K)	< 0.5 Ω•cm	>106 Ω•cm
Dislocation Density	Less than 5x106 cm-2	
Usable Surface Area	> 90%	
Polishing	Front Surface: Ra < 0.2nm. Epi-ready polished Back Surface: Fine ground	
Package	Packaged in a class 100 clean room environment, in single wafer containers, under a nitrogen atmosphere.	

Gallium Antimonide (GaSb) Crystals and Substrates



- Matches well with each ternary, quaternary, and III-V compound
- Maximum diameter: 3 inches
- Non-doping, Zn-doped, and Te-doped GaSb are available.
- Surface Roughness: Ra≤0.5nm
- Clean package: class 1000 clean room and class 100 bags
- Applications: Infrared optical fiber transmission, potential application in the microwave field

Gallium Antimonide (GaAs) is used as a substrate material for the epitaxial growth of heterostructures, which are harnessed for optoelectronic applications. The lattice constant of GaSb matches well with various ternary, quaternary, and III-V compound solid solutions whose bandgap covers 0.8–4.3 μm, which makes it a good substrate material used in infrared optical fiber transmission. With higher lattice-restricted mobility than GaAs, GaSb is expected to have good prospects in the field of microwave.

Hangzhou Shalom EO offers custom GaSb crystals and substrates according to the customer's request, the maximum diameter of 3" is available. Three types of GaSb materials: non-doping, Zinc (Zn) doped and Tellurium (Te) doped GaSb are offered. All substrates are stringently tested and packed in class 1000 clean room and class 100 bags.

Specifications:

Material	GaSb single crystal	Orientation	<100>
Crystal Structure	Cube	Density	5.53g/cm3
Melt Point	712℃	Bandgap(@300 K)	0.67eV
Band Gap@300 K	10x10x0.5mm, 5x5x0.5mm, D50.8x0.5mm, D76.2x0.5mm	Surface Roughness	Ra≤0.5nm5Å
Size(mm)	SSP (single surface polished) or DSP (double surface polished)	Package	class 1000 clean room, class 100 bags

Chemical Properties of GaSb Crystal:

Single Crystal	Doping	Conduction Type	Carrier Concentration	Mobility Ratio	Dislocation Density
GaSb	/	P	(1-2)×1017	600-700	<1x104
GaSb	Zn	P	(5-100)x1017	200-500	<1x104
GaSb	Te	N	(1-20)x1017	2000-3500	<1x104

Germanium (Ge) Crystals and Substrates

- High purity and low surface roughness(Ra)≤5Å (5μm×5μm)
- High chemical stability and good photoelectric performance
- For epitaxial growth or layer-scale transfer of III-V compounds
- Germanium Lenses and Germanium windows for infrared application available
- Various doping options: No doping (R>35Ωcm) or Sb-doped (R=0.05Ωcm) or Ga –doped (R0.05~0.1Ωcm)

Germanium (Ge) is a rare metal and semiconductor material and contains many unique properties and merits. The benefits of Ge include strong chemical resistance, easy processing, high and uniform transmittance, large refractive index, high radiation resistance, and good photoelectric performance. Germanium or Ge substrates are an excellent alternative for epitaxial growth and layer transfer of III-V compounds, because of the similar lattice constants, germanium substrates can be used to make gallium arsenide solar cells.

Germanium substrates are excellent for manufacturing semiconductors, infrared optics, and solar cells. Germanium has a higher intrinsic carrier concentration compared to silicon, making it useful for applications requiring high speed. Germanium is less expensive and more mechanically strong than GaAs, therefore Ge substrates can have a larger length-to-thickness ratio, reducing the weight and cost.

Hangzhou Shalom EO provides germanium crystals, wafers, and substrates that are precisely "off-cut" towards the appropriate directions and packaged in class 1000 clean room and class 100 bags.

Specifications:

Orientation	<100>, <110>, <111>±0.5°	Size(mm)	10x3, 10x5, 10x10, 15x15, 20x15, 20x20 dia2"x 0.33mm dia2"x 0.43mm 15 x 15 mm
Thickness	0.5mm, 1.0mm	Polishing	SSP (single surface polished) or DSP (double surface polished)
Ra	≤5Å(5μm×5μm)		

Basic Properties:

Growth Method	Czochralski	Crystal Structure	M3
Lattice Constant	a=5.65754 Å	Density	5.323g/cm3
Melt Point	937.4℃		
Doping Material	No Doping	Sb-doped	Ga –doped
Type	/	N	P
Resistivity	>35Ωcm	0.05Ωcm	0.05~0.1Ωcm
EPD	<4×103/cm2	<4×103/cm2	<4×103/cm2

GGG Substrates and Wafers

- Exceptional magneto-optical properties, low dielectric loss and high thermal conduction
- Maximum diameter: 4 inches; typical thickness 0.5/1.0mm
- Clean package: class 1000 clean room and class 100 bags
- Typical Orientation of GGG substrates: ＜100＞, ＜110＞ and ＜111＞
- Excellent as magneto-optical isolator, microwave epitaxial substrates, and HTS substrates
- Applications: magneto-optical films (such as YIG or BIG thin film) growth, excellent as optical, microwave isolator and High-Temperature Superconductor (HTS) substrates

Gadolinium Gallium Garnet (GGG) single crystal is a material with exceptional magneto-optical properties, low dielectric loss, and high thermal conduction which make it promising for use in the fabrication of various optical magneto-optical components as well as for epitaxial growth of microwave elements and high-temperature superconductors. GGG substrates can be incorporated into infrared optical isolator (operating from 1.3μm to 1.5μm), which comprises YIG or BIG film deposited on the Gadolinium Gallium Garnet (GGG) substrate combined with birefringence parts. GGG substrates enable the fabrication of high-performance optoelectronic devices such as microwave isolators, light-emitting diodes (LEDs), and photodetectors.

Hangzhou Shalom EO provides standard epi-ready GGG substrates and wafers, custom wafers are also available upon request.

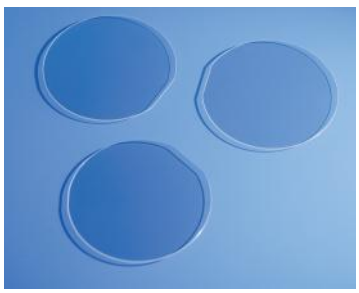
Specifications:

Material	GGG single crystals	Orientation	＜100＞,<110>,<111>
Orientation Error	±0.5°	Maximum Diameter	4 inches
Typical Thickness	0.5mm,1.0mm	Size Tolerance	±0.05mm
Size Tolerance	±0.1mm	Surface Finish	SSP or DSP
Roughness	Ra<0.5nm	Cleanness and Package	class 1000 clean room, class 100 bags

Product List

Code	Size	Thickness	Orientation	Surface Finish	Unit Price
6506-001	5x5mm	0.5mm	<100>	SSP	Inquire
6506-002	5x5mm	0.5mm	<110>	SSP	Inquire
6506-003	5x5mm	0.5mm	<111>	SSP	Inquire
6506-004	10x10mm	0.5mm	<100>	SSP	Inquire
6506-005	10x10mm	0.5mm	<110>	SSP	Inquire
6506-006	10x10mm	0.5mm	<111>	SSP	Inquire
6506-007	Φ12.7mm	0.5mm	<111>	SSP	Inquire
6506-008	Φ12.7mm	0.5mm	<111>	DSP	Inquire
6506-009	Φ25.4mm	0.5mm	<111>	SSP	Inquire
6506-010	φ25.4mm	0.5mm	<111>	DSP	Inquire
6506-011	φ50.8mm	0.5mm	<111>	SSP	Inquire
6506-012	φ50.8mm	0.5mm	<111>	DSP	Inquire
6506-013	φ76.2mm	0.5mm	<111>	SSP	Inquire
6506-014	φ76.2mm	0.5mm	<111>	DSP	Inquire

Glass Wafers and Substrates



- Brands: SCHOTT Borofloat33/B270/D263/N-BK7/Zerodur, Corning Pyrex and Eagle XG, CDGM (China) H-K9L/H-ZF/MJB5
- Specifications compliant with SEMI Standards and QC inspected
- Fused Silica Wafers and Substrates are also available
- Custom dimensions and shapes upon request
- Typical applications: Semiconductor applications, Substrates for Coating of Optical Components (Optical Mirrors, Filters, etc), Microfluidic Chips, LCD, and others

Glass Wafers and Substrates are thin discs or squares of glass materials. The term glass means a vitreous solid formed by rapid cooling after the raw ingredients are heated toward their liquid state.

Shalom EO offers Glass Wafers and Substrates made from glass equivalent to SCHOTT Borofloat33/B270/D263/N-BK7/Zerodur, Corning Pyrex and Eagle XG, CDGM H-K9L/H-ZF/MJB5, and conventional Soda Lime Glass, etc. Glass substrates coated with ITO (Indium Tin Oxide) conducting film for LCD (Liquid Crystal Display) are also available. The advantages of these glass materials include superior thermal and chemical stability, excellent dielectric properties, high spectral optical transmission, etc., which differ according to the glass type.

The wafers and substrates could be provided either in polished (single side or double side optional) versions for high-end applications or unpolished versions at economized prices, where Shalom EO utilizes an abrasion-free lapping and CNC machining process, to achieve exceptionally low Total Thickness Verification (TTV), tight geometric deviations and the desired flatness. Cautious inspections are carried out in clean room before deliveries to ensure qualities are compliant with the SEMI standards.

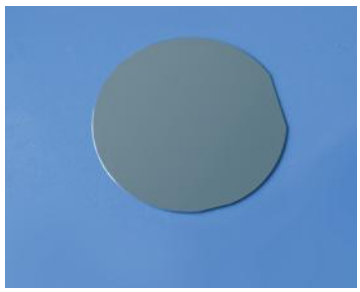
The lowest thickness is down to 3um, and a wide spectrum of Thermal Expansion Coefficients is accessible, with other specifications (shapes, dimensions, material selection, etc.) free for customization. We are also willing to offer constancy at your request.

Specifications:

Note: The Specifications of Standard Glass Wafers and Substrates are listed below, other custom modules with Diameters up to 450mm, and Minimum Thickness of 30μm are available.

Item (Standard)	4 inch	6 inch	8 inch	12 inch
Brands and Materials	SCHOTT Borofloat33/B270/BK7/D263, Corning Eagle XG/Pyrex, CDGM H-K9L/H-ZF/MJB5, Soda Lime Glass			
Diameter (of Round or Square Shape)	100mm	150mm	200mm	300mm
Dimension Tolerance	±0.3mm	±0.3mm	±0.3mm	±0.5mm
Thickness	≥0.15mm	≥0.25mm	≥0.3mm	≥0.3mm
Primary Flat	32±2mm	57.5/42±2mm	Notch	Notch
LTV (5mmx5mm)	<1μm	<1μm	<1μm	<2μm
TTV	<1.5μm	<3μm	<5μm	<5μm
Bow	±20μm	±30μm	±40μm	±50μm
Warp	≤25μm	≤30μm	≤50μm	≤60μm
PLTV (0.5μm within 5mmx5mm)	≥95%	≥95%	≥95%	≤95%
Edge Bevel	According to IEC62276&SEMI M1.2 Standard			
Polished Side Roughness(Ra)	≤1nm			
Surface Quality, S/D	40/20			

Indium arsenide (InAs) Crystals and Substrates



- High mobility ratio and low dislocation density
- Good lattice integrity, appropriate electrical parameters, and high homogeneity
- Substrate material for heterojunction materials and epitaxial growth of AlGaSb
- Surface Roughness(Ra)≤5Å
- Application fields: infrared devices, medium wave infrared quantum cascade laser(QCL), gas monitoring, Hall semiconductors, etc.

Indium Arsenide (InAs) single crystal is often used as the substrate material to grow heterojunction materials (InAsSb/In－AsPSb, InNAsSb), which can be utilized to manufacture infrared-emitting devices within the wavelength range 2～14μm. Indium Arsenide （InAs) can also be used as a substrate material for the epitaxial growth of AlGaSb with a superlattice structure for medium wave infrared quantum cascade laser(QCL). InAs are widely used in gas monitoring and low-loss optical fiber communication. With a high mobility ratio, it is an ideal material for Hall semiconductors. As a single-crystal substrate, Indium Arsenide has low dislocation density, good lattice integrity, appropriate electrical parameters, and high homogeneity. The main growth method of this material is the classical liquid encapsulation pulling method (LEC).

Hangzhou Shalom EO offers custom Indium Arsenide substrate and wafers according to the request, with a good surface roughness of less than 0.5nm and packaged in class 1000 clean room and class 100 bags.

Specifications:

Material	InAs single crystal	Orientation	〈100〉
Crystal Structure	Cube	Density	5.66g/cm3
Melt Point	942℃	Bandgap(@300 K)	0.45eV
Size(mm)	10x10x0.5mm, 5x5x0.5mm, D50.8x0.5mm, D76.2x0.5mm	Surface Roughness	Ra≤5Å
Polishing	SSP (single surface polished) or DSP (double surface polished)	Package	class 1000 clean room, class 100 bags

Modules and Types:

Single Crystal	Doping	Conduction Type	Carrier Concentration	Mobility Ratio	Dislocation Density
InAs	/	N	5x1016	2x104	<5x104
InAs	Sn	N	(5-20)x1017	>2000	<5x104
InAs	Zn	P	(1-20)x1017	100-300	<5x104
InAs	S	N	(1-10)x1017	>2000	<5x104

Indium Phosphide (InP) Wafers and Substrates

- High electron mobility, good radiation stability, and large band gap
- Surface Roughness(Ra)≤5Å
- For epitaxial growth of indium gallium arsenide
- Superior performance in high-power and high-frequency electronics
- S/Fe/Zn doping optional
- Application fields: optical fiber communication, microwave, millimeter wave(MMV), radiation-resistant solar cells, Etc.

Indium Phosphide (InP) is an important III-V compound and semiconductor material with the advantages of high electron mobility, good radiation stability, and large band gap. It has a face-centered cubic ("zincblende") crystal structure, identical to that of GaAs and most of the III-V semiconductors. InP is used as a substrate for epitaxial indium gallium arsenide-based optoelectronic devices. With stable physical and chemical properties, InP finds versatile usages in optical fiber communication, microwave, millimeter wave (MMV), radiation-resistant solar cells, and other fields.

Indium Phosphide (InP) is also utilized in high-power and high-frequency electronics (High-electron-mobility transistor, Heterojunction bipolar transistor) because of its superior electron velocities. It was used with indium gallium arsenide to make record-breaking pseudomorphic heterojunction bipolar transistors that could operate at 604 GHz.

Hangzhou Shalom EO offers Custom Indium Arsenide substrate and wafers according to the customer's request, with a good surface roughness of less than 0.5nm and packaged in class 1000 clean room and class 100 bags.

Specifications:

Material	InP single crystal	Orientation	〈100〉
Size(mm)	Dia50.8×0.35mm,10×10×0.35mm	Density	5.66g/cm3
Polishing	SSP (single surface polished) or DSP (double surface polished)		

Chemical Properties of InP Crystal:

Single Crystal	Doping	Conduction Type	Carrier Concentration	Mobility Ratio	Dislocation Density	Standard Size
InP	/	N	(0.4-2)×1016	(3.5-4) ×103	5×104	Φ2"×0.35mm Φ3"×0.35mm
InP	S	N	(0.8-3) ×1018 (4-6) ×1018	(2.0-2.4) ×103 (1.3-1.6) ×103	3×104 2×103	Φ2"×0.35mm Φ3"×0.35mm
InP	Zn	P	(0.6-2) ×1018	70-90	2×104	Φ2"×0.35mm Φ3"×0.35mm
InP	Fe	N	107-108	≥2000	3×104	Φ2"×0.35mm Φ3"×0.35mm

Basic Properties:

Crystal Structure	Tetrahedral(M4)	Lattice Constant	a = 5.869 Å
Density	4.81g/cm3	Melt Point	1062 °C
Molar Mass	145.792 g/mol	Appearance	Black cubic crystals
Chemical Stability	Slightly soluble in acids	Electron Mobility(@300K)	5400 cm2/(V·s)
Bandgap(@300 K)	1.344eV	Thermal Conductivity(@300K)	0.68 W/(cm·K)
Refractive Index	3.55(@632.8nm)		

Potassium Tantalate (KTaO3) Crystals and Substrates

- Typical thickness 0.5/1.0mm
- Surface Roughness: Ra < 0.5nm
- Clean package: class 1000 clean room and class 100 bags
- Orientation of KTaO3 substrates: ＜100＞, ＜110＞ and ＜111＞
- Applications: ferroelectric devices, epitaxial thin film growth for perovskite materials, High Temperature Superconductor (HTSC) film growth, and semiconductors

Potassium tantalate (or KTaO3) single crystal has a perovskite crystal structure, characterized by its cubic lattice arrangement of potassium, tantalum, and oxygen ions. This structure confers upon KTaO3 a series of intriguing properties including excellent ferroelectric properties, high dielectric constant, and low dielectric loss, transmittance to the VIS and NIR spectra, and high melting point. KTaO3 finds versatile applications as ferroelectric devices, substrates for epitaxial growth of thin films of other perovskite materials, such as complex oxides and high-temperature superconductors, or optical components.

The ferroelectric behavior of KTaO3 at low temperatures enables reversible polarization switching under an external electric field, a trait exploited in ferroelectric memory devices. In addition, KTaO3 possesses a wide transmission range spanning from ultraviolet to infrared wavelengths, making it suitable for optical applications. Its piezoelectric properties further extend its utilities in sensors, actuators, and acoustic devices.

Hangzhou Shalom EO offers KTaO3 crystals and wafers, the unique properties of our KTaO3 crystals and substrates render them indispensable in a diverse range of applications including high-performance capacitors, microwave devices, and ferroelectric memories, waveguides, substrates for epitaxial growth, etc.

Specifications:

Materials	KTaO3 crystals	Orientation	<100> <110> <111>
Orientation Error	±0.5deg	Typical Size (mm)	10x3, 10x5, 10x10, 15x15, 20x15, 20x20
Typical Thickness	0.5mm, 1.0mm	Thickness Tolerance	±0.05mm
Size Tolerance	±0.1mm	Surface Finish	SSP (single surface polished) or
DSP (double surface polished)	936 °C (3)	Thermal Conductivity	58.61 W m-1 K-1 at 293K (6)
Roughness	Ra<0.5nm		

Basic Properties:

Melting Point	1352.2 ℃	Density	7.025 g/cm3
Mohs Hardness	6	Refractive Index	2.226@633nm, 2.152@1539nm
Coefficient of Thermal Expansion	4.027 x 10-6/K	Specific Heat (Temperature J/(Kg)	0.378
Transparent Wavelength Range (nm)	380~4000		

Lanthanum Aluminate (LaAlO3) Substrates

- Maximum diameter: 3 inches, typical thickness 0.5/1.0mm
- Orientation of LaAlO3 substrates: ＜100＞,＜110＞,＜111＞
- Surface Roughness: Ra < 0.5nm
- Clean package: class 1000 clean room, class 100 bags
- Applications: epitaxial growth of high temperature superconductors (HTS), magnetic and ferroelectric thin films, low loss microwave and dielectric resonance applications

LaAlO3 (Lanthanum aluminate) single crystal with a perovskite crystal structure, has a good lattice match to multiple materials with a similar perovskite structure. Its wide bandgap, thermal stabilities, and low dielectric loss make it excellent for applications in electronics of high frequencies, optics, and indispensable platforms for the epitaxial growth and research of thin films and heterostructures. Various materials can be grown on LaAlO2, including complex oxides, high-temperature superconductors, magnetic materials, and multiferroics. LaAlO3 exhibits a high dielectric constant, making it useful in capacitor applications.

Hangzhou Shalom EO provides stock epi-ready LaAlO3 wafers and custom LaAlO3 wafers upon request.

Specifications:

Material	LaAlO3 crystals	Orientation	＜100＞, ＜110＞, ＜111＞
Orientation Error	±0.5°	Maximum Diameter	3 inches
Typical Thickness	0.5mm, 1.0mm	Thickness Tolerance	±0.05mm
Size Tolerance	±0.1mm	Surface Finish	SSP or DSP
Roughness	Ra<0.5nm	Cleanness and Package	class 1000 clean room, class 100 bags

Product List:

Code	Size	Thickness	Orientation	Surface Finish	Unit Price
645-001	5x5mm	0.5mm	<100>	SSP	Inquire
645-002	5x5mm	0.5mm	<100>	DSP	Inquire
645-004	5x5mm	0.5mm	<111>	SSP	Inquire
645-005	10x10mm	0.5mm	<100>	SSP	Inquire
645-006	10x10mm	0.5mm	<100>	DSP	Inquire
645-007	10x10mm	0.5mm	<110>	SSP	Inquire
645-008	10x10mm	0.5mm	<111>	SSP	Inquire
645-009	φ25.4mm	0.5mm	<100>	SSP	Inquire
645-010	φ25.4mm	0.5mm	<100>	DSP	Inquire
645-011	Φ50.8mm	0.5mm	<100>	SSP	Inquire
645-012	Φ50.8mm	0.5mm	<100>	DSP	Inquire
645-013	Φ76.2mm	0.5mm	<100>	SSP	Inquire
645-014	Φ76.2mm	0.5mm	<100>	DSP	Inquire
6506-014	φ76.2mm	0.5mm	<111>	DSP	Inquire

Strontium Lanthanum Aluminate (SrLaAlO4) Crystals and Wafers

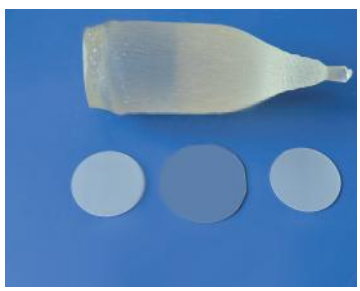
- Lower coefficient of thermal expansion than the other perovskite structure crystals
- Maximum Diameter: 20mm
- Surface Roughness: Ra < 0.5nm
- Clean package: class 1000 clean room and class 100 bags
- Orientation of SrLaAlO4 substrates: ＜001＞
- Applications: complex oxides, high-temperature superconductors, microwaves, high-frequency applications, etc.

Strontium lanthanum aluminate (SrLaAlO4), is a perovskite crystal that shares similarities with SrTiO3 but with a more stable structure and fewer defects. SrLaAlO4 crystal has an excellent lattice match with high-temperature superconductor Yttrium Barium Copper Oxide (YBCO) and other perovskite structure superconductors, which makes it advantageous for growing high TC superconducting films. Compared with other perovskite crystals, SrLaAlO4 has lower thermal expansion coefficients, therefore it can be used to grow films at a lower temperature, improving the lattice mismatch and reducing stress. The low dielectric constants make SrLaAlO4 crystals and wafers superior for microwaves and applications of high-frequencies.
Hangzhou Shalom EO provides custom Strontium lanthanum aluminate crystal wafers.

Specifications:

Material	LaSrAlO4 crystals	Orientation	＜001＞
Orientation Error	±0.5°	Maximum Diameter	20mm
Typical Size	5x5, 10x10,φ12.7mm, φ15mm, φ20mm	Typical Thickness	0.5mm, 1.0mm
Thickness Tolerance	±0.05mm	Size Tolerance	±0.1mm
Surface Finish	SSP or DSP	Roughness	Ra<0.5nm
Cleanness and Package	class 1000 clean room, class 100 bags		

Lithium Aluminate (LiAlO2) Crystals and Substrates



- LiAlO2 remains stable in high-temperature reducing atmospheres, melting point of 1900℃
- Provides LiAlO2 substrates up to 2" in diameter, ensuring high surface roughness
- Available in various sizes (mm) and diameters (Φ), thickness options of 0.5mm or 1.0mm, with orientations including <100> and <001>, and customization available upon request.
- Excellent for III-V nitride thin film growth

Lithium Aluminate (LiAlO2) single crystal with a corundum structure is an exceptional optional as the substrate for III-V nitride thin films since the lattice mismatch between LiAlO2 and Gallium Nitride (GaN) is only 1.4%. LiAlO2 substrate exhibits high chemical stabilities to withstand high-temperature reducing atmosphere. Single-oriented GaN film can be grown on LiAlO2 substrates without using low-temperature buffer layers. Hangzhou Shalom EO can provide LiAlO2 substrates up to 2" in diameter, with high surface roughness and clean packaging.

Specifications:

Size(mm)	10×3, 10×5, 10×10, 15×15, 20×15, 20×20 Φ15, Φ20, Φ1〞, Φ2〞, Φ2.6〞	Thickness	0.5mm,1.0mm
Orientation	<100>, <001>	Orientation Tolerance	±0.5°
Note	Special size and orientation are available upon request	Redirection the Edge	2°(special in 1°)
Surface Roughness	≤5Å(5μm×5μm)	Polishing	SSP (single surface polished) or DSP (double surface polished)

Basic Properties:

Crystal Structure	M4	Lattice Constant	a=5.17 Å c=6.26 Å
Melt Point(℃)	1900	Density	2.62 g/cm3
Hardness	7.5(mohs)	Color and Appearance	Transparent

Langasite (LGS) Crystals and Wafers

- Optimized for surface acoustic wave (SAW) and bulk acoustic wave (BAW) devices
- High thermal stability with temperature up to 900 ℃
- High electro-mechanical coupling factor (15.8%)
- Diameters of wafers: ☒6-76.2mm

Langasite crystal (La3Ga5SiO14, LGS), also called Lanthanum gallium silicate, belonging to the space group P321, point group 32, is a novel piezoelectric material with great potential for the fabrication of surface acoustic wave (SAW) and bulk acoustic wave (BAW) devices.

The LGS crystal has a higher electromechanical coupling factor (15.8%) than that of a quartz crystal, and the value indicates the effectiveness with which a piezoelectric material converts electrical energies into mechanical energies. It is also worth noting that the propagation velocities of a surface acoustic wave in LGS crystal is much lower, this value determines the filter size. When manufacturing quartz and LGS filters operating at the same center frequency, the geometrical dimensions of LGS filters can be made smaller, which conforms with the trend of the dense integration of modern electronics and saves production cost. In addition, The devices made of langasite crystal could be used at high temperatures up to 900 ℃ because of its high thermal stability.

Hangzhou Shalom EO offers the LGS crystals blanks, polished substrates, and wafers upon customers' request.

LGS Crystals Blanks or Blocks:

X Direction	5~40mm	Y Direction	5~40mm
Z Direction	~80mm	Direction Precision	±20′

Langasite Slices:

Diameter	5~14mm	Frequency	2.7~21MHz
Direction Precision	±20′	Surface Roughness(Lapped)	Ra=0.3~0.5μm

Sensor, SAW Wafers:

Diameter	6~76.2mm	Thickness	0.13~0.5mm
Reference Flat	2~15mm	Surface Roughness (CMP single or double sides)	Ra≤1nm
Orientation	Following customer specifications		

Table 1. Basic Properties of Langasite

Constant	Relative Dielectric Constant		Piezoelectric Constant (pC/N)		Elastic Stiffness (1011Pa)					
	ε11	ε33	d11	d14	c11	c12	c13	c14	c33	c44
Value	18.96	50.19	5.66	-5.48	1.898	1.058	1.022	0.144	2.626	0.535
First Order Temp.Coef. (10-6.K-1)	150	-760	329	-342	-66	204	-75	-335	-94	-63

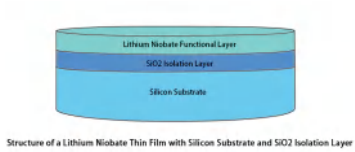
Table 2. Comparative Parameters of Piezoelectric Crystals

Crystals	Quartz SiO2	Langasite La3Ga5SiO14	Lithium tetraborate Li2B4O7	Lithium Tantalite LiTa3
Electromechanical Coupling Factor K%(BAW)	7.0	15.8	24.0	47.0
Frequency Spacing Δf, %	0.25	0.90	4.00	7.00
Q-Factor Q, x103	100	50	10	2
Temperature Frequency Coefficient TFC, x10-6/°C	0.5	1.6	6.0	4.0

Table 3 SAW Properties of Langasite and Quartz

Crystals	Quartz(SiO2)	Langasite(La3Ga5SiO14)
Density (g/cm3)	2.65	5.746
SAW Velocity Vef (m/s)	(0°,132.75 °,0 °)3157	(0°,140 °,25 °)2756
K2emc,%(SAW)	0.14	0.36
Second order temp.coef. α2(x10-8/°C2)	-3.2	-6.8
Temp. Coef. TTO(°C)	25	23
Dielectric Constant (ε)	4.92	27
Power flow angle Φ, °	0	0.5

LiNbO3- LNOI or Ultra-thin LiNbO3 film (300-900nm)



Structure of a Lithium Niobate Thin Film with Silicon Substrate and SiO2 Isolation Layer

- High electro-optical, nonlinear optical, electro-mechanical coefficients
- Diameters: 3", 4", 6", 8"
- Top functional layer ultra-thin thickness: 300-900nm
- Versions with optional SiO2 isolation layers and Si/LN/Quartz/Fused Silica substrates are available
- Applications: data centers, long-distance data transmission, mobile phones, base stations, etc.

Lithium Niobate on Insulator (LNOI) Lithium niobate on insulator (LNOI) is a promising platform for integrated photonics. It involves transferring thin films of lithium niobate onto insulating substrates, such as silicon dioxide or silicon nitride. This technique allows for the integration of lithium niobate-based devices, which are known for their excellent electro-optical, nonlinear-optical, and piezoelectric properties, with existing silicon photonics platforms.

Lithium Niobate is a versatile and excellent material with high nonlinearities and exclusive electro-optical, and piezoelectric properties. One significant advantage of LNOI is its high electro-optical coefficient, which enables efficient modulation of light signals with low power consumption. This trait is essential for developing high-speed optical modulators used in data communication devices. In addition, the nonlinear optical properties of lithium niobate allow for the generation of new frequencies through processes such as second-harmonic generation and parametric amplification. Thin Film LiNbO3 modulator reduces the detrimental free-carrier effect, delivering the advantages of compact size, broad bandwidth, high data transfer rates, compliance with CMOS voltage drivers, and low power consumption. LNOI Filters excel in wide bandwidth, high frequencies, and better thermal properties. LNOI is also an excellent technique to manufacture ultra-low loss resonators.

With the development of matured nanofabrication techniques, Shalom EO is capable of providing nano-scale 300-900nm Lithium Niobate On Insulator (LNOI). Our LiNbO3 on insulator consists of a top functional ultra-thin film of Lithium Niobate with a thickness range of 300-900nm, a supporting substrate made from Silicon/Quartz/Lithium Niobate/Fused Silica, and an optional SiO2 isolation layer. The LNOI features low insertion losses, reliable stabilities, and are exquisite when used to manufacture high-speed electro-optical modulators, and high-performance SAW filters, and are fit for application contexts such as data centers, long-distance data transmission, mobile phones, base stations, etc.

Specifications:

Layers	Parameter	Specifications			
Top Functional Layer	Material	Lithium Niobate			
	Diameter	3"	4"	6"	8"
	Surface Orientation	X-cut or according to request			
	Primary Flat Orientation	according to request			
	Secondary Flat Orientation	according to request			
	Film Thickness	300-600nm			
	Front Side Finish	Optical Polished			
Isolation Layer	Buried Oxide Avg. Thickness	4600nm	4700nm	4800nm	/
	Buried Oxide Thickness Uniformity	-5%	0%	5%	/
Support Substrate	Material	Si, Ln, Sapphire, Quartz, etc.			
	Diameter	3"	4"	6"	8"
	Thickness	0.525mm	0.525mm	0.675mm	0.725mm
	Growth Method	CZ	CZ	ZVD	Hydrothermal
	Orientation	{100}		0.5	deg.
	Dopant	Phos			
	Surface Finish			10	nm

Lithium Tantalate On Insulator (LTOI) 300-900nm

- Ultra-thin thickness 300-900nm LiTaO3 thin films constructed on silicon substrates
- Unique electro-optical, pyroelectric, piezoelectric, and properties
- Diameters: 3", 4", 6"(typical), or other custom diameters
- Orientations:Y-42, Y-46.3, Z, etc.
- Optional SiO2 isolation layers are available
- Applications: integrated photonic devices, high-performance RF filters, mobile phones, and wireless communication

Lithium Tantalate On Insulator (LTOI) represents a cutting-edge platform in the field of integrated photonics and electronics, offering a fusion of the unique properties of lithium tantalate (LiTaO3) with the scalabilities and compatibilities of insulating substrates.

Lithium tantalate (LiTaO3) is renowned for its exceptional nonlinear-optical, piezoelectric, and nonlinear optical properties. Its high electro-optic coefficient and nonlinearities facilitate efficient modulation of light signals. High damage thresholds and high photorefractive damage make LTOI a promising material platform for high-power and short-wavelength (down to the UV) integrated photonic devices. With excellent piezoelectric properties, LTOI can convert mechanical energies into electrical energies with high efficiencies, rendering them an attractive candidate for high-performance RF filters, mobile phones, and wireless communication.

Hangzhou Shalom EO offers custom Lithium Tantalate On Insulator (LTOI) consisting of a LiTaO3 thin film on a silicon substrate. Various cut directions are available, the thickness of the functional LiTaO3 layer is 300-900nm, and SiO2 insulation layers are optional.

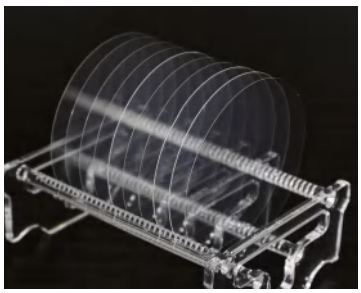
Specifications:

Top Functional Layer	
Diameter	3, 4, 6 inches, or other custom diameters
Orientation	Y-42, Y-46.3, Z, etc.
Material	LiTaO3
Thickness	300-900 nm
Isolation Layer	
Material	SiO2
Thickness	300-4000nm
Substrate	
Material	Si
Thickness	400-500μm

Modules or Types:

Single-crystal Lithium Tantalate Thin Film
SiO2
Silicon Substrates

20-100μm Ultra Thin LiTaO3 Wafers



- Ultra-thin free-standing wafers
- Dimensions: diameters: 3, 4 inches
- Thickness range: 20-100μm
- Orientations: X, Y, Z, etc.
- Material: LiTaO3
- Surface finish options: Single side or Double sides polished

Shalom EO offers custom 20-100μm ultra-thin LiTaO3 wafers, the wafers are available in free-standing versions without substrate. Our ultra-thin LiTaO3 wafers have versatile functions and are excellent when incorporated into pyroelectric gas detectors and pyroelectric flame detectors. The sensors based on these ultra-thin LiTaO3 wafers excel in high sensitivities.

Specifications:

Top Functional Layer	
Diameter	3, 4 inches
Orientation	X, Y, Z, etc.
Material	LiTaO3
Thickness	20-100μm
Surface	Single-side or double-side polished

5-50 μm LT, LN, Quartz on Silicon

- Dimensions: diameters: 3,4 inches, thicknesses: 5-50μm
- Orientations:X, Y-42, Y-46.3, Z, etc.
- Top functional layers made of LiTaO3, LiNbO3, Quartz available
- Silicon substrates with thicknesses of 230-500μm available

This catalog specifies Shalom EO's Lithium Niobate On Insulator (LNOI), Lithium Tantalate On Insulator (LTOI), and Quartz on Insulator consisting of LiNbO3, LiNbO3, or quartz thin films constructed on silicon substrates. The thickness range of the top functional thin film is 5μm-50μm, and the thickness range of the Si substrates is 230-500μm.

Specifications:

Top Functional Layer	
Diameter	3, 4, 6 inches
Orientation	X, Y-42, Y-46.3, Z, etc.
Material	LiTaO3, LiTaO3, Quartz, etc.
Thickness	5-50μm
Substrate	
Material	Si
Thickness	230-500μm

Modules or Types:

Single-crystal Lithium Tantalate Thin Film
Silicon Substrates

Single-crystal Lithium Niobate Thin Film
Silicon Substrates

Single-crystal Quartz Thin Film
Silicon Substrates

Customized Thin Films

- Various modules consisting of top functional thin films, substrates, and electrodes or single/multi-layer structures for choosing
- Thickness 0.1-50μm or customized
- The top layer is made of LTOI/ LNOI/Quartz
- Substrates made of SiO2, Si, Sapphire, Quartz, etc.
- Electrode layers made of Au, Pt, Cr, Al, etc.
- Doped with MgO, Fe, Er, Tm, etc.

Hangzhou Shalom EO provides a series of customized thin films including LiNbO3, LiTaO3, and Quartz thin films deposited on substrate materials including a diverse range: SiO2, Si, Sapphire, Quartz, etc., where multiple other parameters can be tailored upon request. We utilize the meticulous engineering of various electrodes/waveguides, periodical poling, doping, etc., and orientations to meet your specific requirements.

Modules or Types:

Customized Lithium Niobate, Lithium Tantalate & Quartz Thin Films							
Top Layer/ Details			Substrate Details		Top Layer Thin Film Details		
Top Layer/ Details	Multilayer Structure	Patterned Electrode & Waveguide	Different Material (SiO2, Si, Sapphire, Quartz etc.)	Special Size	Electrode(Au,Pt, Cr, Al, etc.)	Orientation (Same as Bulb Wafers)	Doped(MgO, Fe, Er, Tm, etc.)
100-1000 nm LiNbO3	√	√	√	√	√	√	√
100-1500 nm LiTaO3	√	√	√	√	√	√	√
5-50μm LiNbO3	√		√	√		√	
5-50μm LiTaO3	√		√	√		√	
5-50μm Quartz		√	√	√		√	

Optical Grade LiNbO3 Crystal Wafers

- High electro-optical and High nonlinear optical coefficients
- Diameter 2", 3", 4" or custom
- Minimum thickness: 0.05mm
- SAW Grade LiNbO3 Wafers are also available
- Crystal ingots, blanks, and customized wafers and substrates available
- Applications: Polarizers for Optic Isolators, Integrated Waveguides, EO Phase Modulators, Optical Modulator, Optical Isolators, Electro-optic Q-switches, fifth-generation wireless communication (5G), micro-nano photonics, integrated photonics, quantum optics

Optical grade lithium niobate (LiNbO3) wafers are wafers made of lithium niobate with little impurities and defects, which meets the critical requirements for optical applications. LinbO3 has many merits that make them outstanding as optical grade wafers, including high electro-optical and high nonlinear optical coefficients, a wide transmission wavelength range (0.3 - 5 μm), a high index of refraction, and reliable chemical and mechanical stabilities. These traits permit the efficient and precise control of light.

Hangzhou Shalom EO offers optical grade lithium niobate (LiNbO3) crystal ingots, blanks, wafers, and substrates, both off-the-shelf and custom products are available. Advanced facilities are equipped for crystal growing, wafer cutting, lapping, and polishing. Before shipping, a stringent testing process is taken under our ISO9001-certified QC system. Shalom EO also provides a variety of LiNbO3 crystal-based products, including SAW LiNbO3 wafers and substrates, MgO doped LiNbO3 crystals and wafers, Periodically poled lithium niobate (PPLN), LiNbO3 crystal for EO Phase Modulators, Optical Modulator applications, and Lithium Niobate Electro-optical (EO) pockels cells.

Common Specifications:

Material	Optical regular and optical super Grade LiNbO3	
Curie Temp	1142±2.0℃	
Cutting Angle	X/Y/Z etc	
Diameter/Size	2"/3"/4"	
Tol(±)	<0.20 mm	
Thickness	0.18 ~ 1.0mm or more	
Primary Flat	16mm/22mm /32mm	
Orientation Flat	All available	
Surface Type	Single Side Polished /Double Sides Polished	
Polished side Ra	<0.5nm	
Surface Quality	20/10 S/D	
Edge Criteria	R=0.2mm or Bullnose	
Wafer Surface Criteria	Refractive index	No=2.2878/Ne=2.2033 @632nm wavelength
	Contamination	None
	Particles ℄ >0.3 μm	<= 30
	Scratch , Chipping	None
	Defect	No edge cracks, scratches, saw marks, stains

Product List of Optical Grade LiNbO3 Crystal Wafers

Code	Material	Diameter	Thickness	Orientation	Surface Finish	Unit Price
631-001	Optical Grade LiNbO3	Φ76.2mm	0.35mm	X-cut	DSP	Inquire
631-002	Optical Grade LiNbO3	Φ76.2mm	0.35mm	Z-cut	DSP	Inquire
631-003	Optical Grade LiNbO3	Φ76.2mm	0.5mm	X-cut	DSP	Inquire
631-004	Optical Grade LiNbO3	Φ76.2mm	0.5mm	Z-cut	DSP	Inquire
631-005	Optical Grade LiNbO3	Φ100mm	0.35mm	X-cut	DSP	Inquire
631-006	Optical Grade LiNbO3	Φ100mm	0.35mm	Z-cut	DSP	Inquire
631-007	Optical Grade LiNbO3	Φ100mm	0.5mm	X-cut	DSP	Inquire
631-008	Optical Grade LiNbO3	Φ100mm	0.5mm	Z-cut	DSP	Inquire
631-009	Optical Grade LiNbO3	Φ100mm	1.0mm	X-cut	DSP	Inquire
631-010	Optical Grade LiNbO3	Φ100mm	1.0mm	Y-cut	DSP	Inquire
631-011	Optical Grade LiNbO3	Φ100mm	1.0mm	Z-cut	DSP	Inquire

SAW Grade LiNbO3 Wafers

- Diameters: 2.5", 3", 4" and 6"
- Orientations: X, Y, Z, Y36, Y41, Y45, Y64, Y128, Y135
- Crystal ingots, blanks, and customized wafers available
- Curie Temperature and QC Tested
- Optimized for surfaced acoustic wave (SAW) devices
- Optical Grade LiNbO3 Crystal Wafers, MgO:LiNbO3 crystals for EO application, Nonlinear LiNbO3 and MgO:LiNbO3, and MgO:PPLN Crystals are also available

Lithium niobate crystal, referred to as LN, belongs to the trigonal crystal system with a distorted perovskite-type structure. The LiNbO3 crystal exhibits manifold useful properties, including piezoelectric, ferroelectric, photoelectric, nonlinear optical, thermoelectric, etc. SAW grade LN wafers are wafers assigned to usages for Surface Acoustic Wave (SAW) devices, which convert acoustic waves to electrical signals by exploiting the piezoelectric effect of the materials. Compared with the normal lithium niobate, the saw grade niobate could be discriminated by higher near ultra-violet absorption and lower pyroelectric charge attributed to higher electrical conductivities. As a SAW-grade material, the competitiveness of LiNbO3 is composed of high electromechanical coupling factors and low insertion loss, which allow the LN wafer to transform the energies with high efficiencies.

Hangzhou Shalom EO offers the SAW grade lithium niobate (or LiNbO3) crystals and wafers, advanced facilities are equipped, and cutting-edge techniques are utilized for crystal growth, wafer cutting, wafer lapping, wafer polishing and wafer checking, all finished products pass Curie Temp testing and stringent QC inspections. Our LiNbO3 Wafers could be integrated into various SAW devices such as resonators, filters, and delay lines with excellent fitness. SAW grade or acoustical grade LiNbO3 crystals are available in the form of boules or ingots, blanks, wafer blanks, and polished wafers. Optical Grade LiNbO3 Crystal Wafers, MgO:LiNbO3 crystals for EO application, Nonlinear LiNbO3 and MgO:LiNbO3, and MgO:PPLN Crystals are also available.

LiNbO3 Crystal Specifications:

Crystals Orientations	X,Y,Z, Y36, Y41,Y49, Y64,Y128, Y135	Orientation Fluctuation	±0.30°
Diameter	2.5", 3", 4" and 6", or customized	Length	50~100mm
Curie Temp	1142±3°C	Orientation of First Reference Flat	As required ±0.2 0
Length of First Reference Flat	32±2 mm (4 "),22±2 mm (3 ") inspection polished.	Second Reference Flat	Available if required, the length shall be 12±3 mm (4 "),10±3mm(3 ")
Appearance	Free of crack, pore, inclusion		

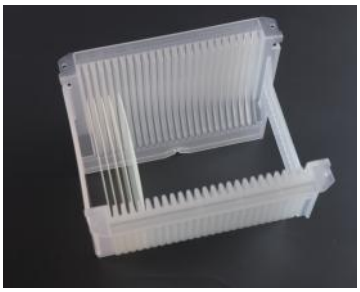
Specifications for 3"/4"/5"/6" LN Wafers

Specifications for 3"/4"/5"/6" LN wafers				
Wafer Size	3"	4"	5"	6"
Diameter(mm)	76.2	100	125	150
Tolerance (±mm)	0.25	0.5	0.5	0.5
Primary Reference Flat (mm)	22mm or customized	32.5mm or customized	42.5mm or customized	57.5mm or customized
Cutting Angle	X,Y,Z, Y36, Y41,Y64,Y49,Y128, Y135			
Orientation Flat	All available			
Surface Type	Single side polished/Double sides polished			
Polished Side Ra (nm)	≤1			
Back Side Criteria (μm)	General is 0.2-0.5 or as customized			
Edge Rounding	Compliant with SEMI M1.2 Standard/refer to IEC62276			
Appearance	Contamination: None			
	Particles Φ>0.3μm: ≤30			
	Saw Marks, striations: None			
	Scratch: None			
	Cracks, crowsfeet, Saw marks, strains: None			

Product List of SAW Grade LiNbO3 Wafers

Code	Material	Diameter	Thickness	Orientation	Surface Finish	Unit Price
611-001	SAW LiNbO3	Φ76.2mm	0.35mm	Y36-cut	SSP	Inquire
611-002	SAW LiNbO3	Φ76.2mm	0.35mm	Y128-cut	SSP	Inquire
611-003	SAW LiNbO3	Φ76.2mm	0.35mm	Y36-cut	DSP	Inquire
611-004	SAW LiNbO3	Φ76.2mm	0.35mm	Y128-cut	DSP	Inquire
611-005	SAW LiNbO3	Φ76.2mm	0.35mm	Y-cut	SSP	Inquire
611-006	SAW LiNbO3	Φ76.2mm	0.35mm	Y-cut	DSP	Inquire
611-007	SAW LiNbO3	Φ76.2mm	0.5mm	Y36-cut	SSP	Inquire
611-008	SAW LiNbO3	Φ76.2mm	0.5mm	Y128-cut	SSP	Inquire
611-009	SAW LiNbO3	Φ76.2mm	0.5mm	Y36-cut	DSP	Inquire
611-010	SAW LiNbO3	Φ76.2mm	0.5mm	Y128-cut	DSP	Inquire
611-011	SAW LiNbO3	Φ76.2mm	0.5mm	Y-cut	SSP	Inquire
611-012	SAW LiNbO3	Φ76.2mm	0.5mm	Y-cut	DSP	Inquire
611-013	SAW LiNbO3	Φ100mm	0.35mm	Y36-cut	SSP	Inquire
611-014	SAW LiNbO3	Φ100mm	0.35mm	Y128-cut	SSP	Inquire
611-015	SAW LiNbO3	Φ100mm	0.35mm	Y36-cut	DSP	Inquire
611-016	SAW LiNbO3	Φ100mm	0.35mm	Y128-cut	DSP	Inquire
611-017	SAW LiNbO3	Φ100mm	0.35mm	Y-cut	SSP	Inquire
611-018	SAW LiNbO3	Φ100mm	0.35mm	Y-cut	DSP	Inquire
611-019	SAW LiNbO3	Φ100mm	0.5mm	Y36-cut	SSP	Inquire
611-020	SAW LiNbO3	Φ100mm	0.5mm	Y128-cut	SSP	Inquire
611-021	SAW LiNbO3	Φ100mm	0.5mm	Y36-cut	DSP	Inquire
611-022	SAW LiNbO3	Φ100mm	0.5mm	Y128-cut	DSP	Inquire
611-023	SAW LiNbO3	Φ100mm	0.5mm	Y-cut	SSP	Inquire
611-024	SAW LiNbO3	Φ100mm	0.5mm	Y-cut	DSP	Inquire
611-025	SAW LiNbO3	Φ150mm	0.5mm	Y128-cut	SSP	Inquire
611-026	SAW LiNbO3	Φ150mm	0.5mm	Y128-cut	DSP	Inquire
611-027	SAW LiNbO3	Φ150mm	0.5mm	Y-cut	SSP	Inquire
611-028	SAW LiNbO3	Φ150mm	0.5mm	Y-cut	DSP	Inquire
611-029	SAW LiNbO3	Φ150mm	1.0mm	X-cut	DSP	Inquire
611-030	SAW LiNbO3	Φ150mm	1.0mm	Y-cut	DSP	Inquire
611-031	SAW LiNbO3	Φ150mm	1.0mm	Z-cut	DSP	Inquire

Optical Grade LiTaO3 Crystal Wafers



- Diameter: 2", 3"
- Minimum thickness: 0.05mm
- Crystals ingots, blanks, wafers, substrates available
- No surface defects (no edge cracks, scratches, saw marks, stains)
- Applications: electro-optical modulator, optical fiber communications applications

Lithium Tantalate (LiTaO3), referred to as LT, is a crystal with a perovskite structure. LiTaO3 exhibits distinguished optical, piezoelectric, and pyroelectric properties. For different applications, the critical parameters of LiTaO3 differ. Optical grade LiTaO3 crystal wafers boast a unique set of properties that make them ideal for optical applications. Optical grade LiTaO3 exhibits high optical transmission across a broad spectrum, spanning from ultraviolet to near-infrared wavelengths. The strong electro-optic effect of LiTaO3 allows for efficient modulation of light with low drive voltages, enabling the manipulation and modulation of optical signals for data communication and signal processing. In addition, LT possesses consistent optical characteristics throughout its volume and low optical absorption, facilitating efficient light transmission with minimum distortions, aberrations, or other undesirable effects.

Hangzhou Shalom EO offers optical grade lithium tantalate (LiTaO3) crystal ingots, blanks, wafers, and substrates, both off-the-shelf and custom products are available. Advanced facilities are equipped for crystal growing, wafer cutting, lapping, and polishing. Before shipping, a stringent testing process is taken under our ISO9001-certified QC system.

Specifications:

Material	Optical Grade LiTaO3	
Curie Temp	603±2℃	
Cutting Angle	X/Y/Z etc	
Diameter/Size	2"/3"/4"	
Tol(±)	<0.20 mm	
Thickness	0.18 ~ 1.0mm or more	
Primary Flat	16mm/22mm /32mm	
Orientation Flat	All available	
Surface Type	Single Side Polished /Double Sides Polished	
Polished Side Ra	<0.5nm	
Back Side Criteria	General 0.2-0.5μm or as customized	
Surface Quality	20/10 S/D	
Edge Criteria	R=0.2mm or Bullnose	
Wafer Surface Criteria	Contamination	None
	Particles ∅ >0.3 μm	<= 30
	Scratch , Chipping	None
	Defects	No edge cracks, scratches, saw marks, stains

Product List of Optical Grade LiTaO3 Crystal Wafers

Code	Material	Diameter	Thickness	Orientation	Surface Finish	Unit Price
632-001	Optical LiTaO3	Φ76.2mm	0.35mm	X-cut	DSP	Inquire
632-002	Optical LiTaO3	Φ76.2mm	0.35mm	Z-cut	DSP	Inquire
632-003	Optical LiTaO3	Φ76.2mm	0.5mm	X-cut	DSP	Inquire
632-004	Optical LiTaO3	Φ76.2mm	0.5mm	Z-cut	DSP	Inquire
632-005	Optical LiTaO3	Φ100mm	0.35mm	X-cut	DSP	Inquire
632-006	Optical LiTaO3	Φ100mm	0.35mm	Z-cut	DSP	Inquire
632-007	Optical LiTaO3	Φ100mm	0.5mm	X-cut	DSP	Inquire
632-008	Optical LiTaO3	Φ100mm	0.5mm	Z-cut	DSP	Inquire

SAW Grade LiTaO3 Wafers

- Unique piezoelectric properties
- Diameters: 2", 3", 4", and 6"
- Orientations: Y, Y36 ,Y42, Y48, Y128, X-112Y
- Crystal ingots, blanks, polished wafers, and customized wafers available
- Curie Temp and QC Tested
- Applications: surfaced acoustic wave (SAW) devices

Lithium tantalate (LiTaO3), referred to as LT, belongs to the trigonal system, with a distorted perovskite structure and point group c63vr3c.

SAW Grade Lithium tantalate is optimized for Surface Acoustic Wave (SAW) uses with exceptional piezoelectric properties, allowing efficient transferring of mechanical signals into electrical signals. Polished LT wafers are often used for manufacturing a diverse range of SAW devices resonators, filters, transducers, and other electronic communication devices, attributed to their good mechanical and electrical coupling, temperature coefficient, and other comprehensive performance. SAW grade LT finds prominence in fabricating high-frequency surface acoustic wave devices and multiple high-end communication fields such as mobile phones, walkie-talkies, satellite communications, aerospace, and so on.

Hangzhou Shalom EO offers SAW-grade lithium Tantalate (or LiTaO3) crystals and wafers, advanced facilities are equipped for crystal growing, wafer cutting, wafer lapping, wafer polishing, and wafer checking, and all finished products will undergo Curie Temp testing and QC inspections. The SAW grade LiTaO3 crystals are available in various forms including boules, blanks, wafer blanks, and polished wafers.

Specifications:

Crystals Orientations	X,Y,Z, Y36, Y42,Y48, X-112Y	Orientation Fluctuation	±0.30°
Diameter	2", 3", 4", 6" and customized	Length	50~80mm
Curie Temp	605±3°C	Orientation of First Reference Flat	As required ±0.2 0
Length of First Reference Flat	32±2 mm (4 "), 22±2 mm (3 ") inspection polished	Second Reference Flat	Available if required, the length shall be 12±3 mm (4 "), 10±3mm(3 ")
Appearance	Free of crack, pore, inclusion		

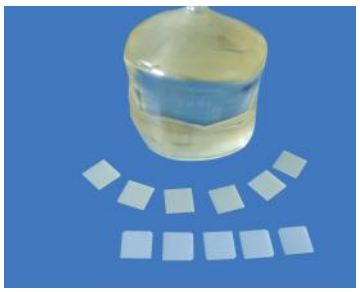
Specifications for 3"/4" LT Wafers

Wafer Size	3"	4"	6"
Diameter(mm)	76.2mm	100mm	150mm
Tolerance (±mm)	0.25	0.5	0.5
Primary Reference Flat (mm)	22mm or customized	32.5mm or customized	57.5mm or customized
Cutting Angle	X,Y,Z, Y36, Y42,Y48,X-112Y etc.		
Orientation Flat	All available		
Surface Type	Single side polished/Double sides polished		
Polished Side Ra (nm)	≤1		
Back Side Criteria (μm)	General is 0.2-0.5 or as customized		
Edge Rounding	Compliant with SEMI M1.2 Standard/refer to IEC62276		
Appearance	Contamination: None		
	Particles Φ>0.3μm: ≤30		
	Saw Marks, striations: None		
	Scratches: None		
	Cracks, crowsfeet, Saw marks, strains: None		

Product List of SAW Grade LiTaO3 Wafers

Code	Material	Diameter	Thickness	Orientation	Surface Finish	Unit Price
612-001	SAW LiTaO3	Φ76.2mm	0.35mm	Y42-cut	SSP	Inquire
612-002	SAW LiTaO3	Φ76.2mm	0.35mm	X112-Y	SSP	Inquire
612-003	SAW LiTaO3	Φ76.2mm	0.35mm	Y42-cut	DSP	Inquire
612-004	SAW LiTaO3	Φ76.2mm	0.35mm	X112-Y	DSP	Inquire
612-005	SAW LiTaO3	Φ76.2mm	0.5mm	Y42-cut	SSP	Inquire
612-006	SAW LiTaO3	Φ76.2mm	0.5mm	X112-Y	SSP	Inquire
612-007	SAW LiTaO3	Φ76.2mm	0.5mm	Y42-cut	DSP	Inquire
612-008	SAW LiTaO3	Φ76.2mm	0.5mm	X112-Y	DSP	Inquire
612-009	SAW LiTaO3	Φ100mm	0.35mm	Y42-cut	SSP	Inquire
612-010	SAW LiTaO3	Φ100mm	0.35mm	X112-Y	SSP	Inquire
612-011	SAW LiTaO3	Φ100mm	0.35mm	Y42-cut	DSP	Inquire
612-012	SAW LiTaO3	Φ100mm	0.35mm	X112-Y	DSP	Inquire
612-013	SAW LiTaO3	Φ100mm	0.5mm	Y42-cut	SSP	Inquire
612-014	SAW LiTaO3	Φ100mm	0.5mm	X112-Y	SSP	Inquire
612-015	SAW LiTaO3	Φ100mm	0.5mm	Y42-cut	DSP	Inquire
612-016	SAW LiTaO3	Φ100mm	0.5mm	X112-Y	DSP	Inquire

LSAT Substrates



- Maximum diameter: 2 inches, typical thickness 0.5/1.0mm
- Orientations of LSAT substrates:＜100＞,＜110＞,＜111＞
- Stock and custom LSAT substrates available
- Surface Roughness: Ra < 0.5nm
- Clean package: class 1000 clean room and class 100 bags
- Applications: for epitaxial thin film growth in ferroelectric and high temperature superconductor (HTS) devices

LSAT - Lanthanum Strontium Aluminum Tantalum Oxide or (La,Sr)(Al,Ta)O3, abbreviated as LSAT, is a crystal with a mixed perovskite structure. LSAT is a hard, transparent oxide composed of the elements lanthanum, aluminum, strontium, and tantalum. LSAT substrates are widely used for epitaxial growth of ferroelectric and high temperature superconductor (HTS) thin films, and in particular popular for epitaxial oxides and their heterostructures, often for the researching purpose of electron correlation phenomena. Typical materials grown on LSAT substrates include strontium titanate (SrTiO3), cuprate superconductors (such as YBCO), iron-based superconductors (iron-pnictides), rare-earth manganites, rare-earth nickelates, and others. Semiconductors such as gallium nitride can also be grown on LSAT.

Common Specifications:

Material	LSAT crystals	Orientation	＜100＞, ＜110＞, ＜111＞
Orientation Error	±0.5°	Maximum Diameter	2 inches
Typical Thickness	0.5mm, 1.0mm	Thickness Tolerance	±0.05mm
Size Tolerance	±0.1mm	Surface Finish	SSP or DSP
Roughness	Ra<0.5nm	Cleanness and Package	class 1000 clean room and class 100 bags

Basic Properties:

Growth Method	Czochralski method	Crystal Structure	M3
Unit Cell Constant	a=3.868 Å	Melt Point（℃）	1840
Density	6.74（g/cm3）	Hardness	6.5（mohs）
Dielectric Constants	22	Thermal Expansion	10 x 10-6 /K

Product List of LSAT Substrates

Code	Size	Thickness	Orientation	Surface Finish	Unit Price
643-001	5x5mm	0.5mm	<100>	SSP	Inquire
643-002	5x5mm	0.5mm	<100>	DSP	Inquire
643-003	5x5mm	0.5mm	<110>	SSP	Inquire
643-004	5x5mm	0.5mm	<111>	SSP	Inquire
643-005	10x10mm	0.5mm	<100>	SSP	Inquire
643-006	10x10mm	0.5mm	<100>	DSP	Inquire
643-007	10x10mm	0.5mm	<110>	SSP	Inquire
643-008	10x10mm	0.5mm	<111>	SSP	Inquire
643-009	Φ12.7mm	0.5mm	<100>	SSP	Inquire
643-010	Φ12.7mm	0.5mm	<100>	DSP	Inquire
643-011	Φ25.4mm	0.5mm	<100>	SSP	Inquire
643-012	Φ25.4mm	0.5mm	<100>	DSP	Inquire
643-013	Φ50.8mm	0.5mm	<100>	SSP	Inquire
643-014	Φ50.8mm	0.5mm	<100>	DSP	Inquire

Magnesium Aluminate (MgAlO4) Substrates

- Stocked and custom MaAl2O4 (or Spinel) Substrates available
- Maximum diameter: 2 inches, typical thickness 0.5/1.0mm
- Surface Roughness: Ra < 0.5nm
- Clean package: class 1000 clean room and class 100 bags
- Orientation of MgAl2O4 substrates:＜100＞,＜110＞,＜111＞
- Applications: ferroelectric/HTSC thin film growth, epitaxial thin film growth of high-quality GaN films, III-V nitrides thin film growth, bulk acoustic wave and microwave devices

Magnesium Aluminate (MgAl2O4) single crystals, also known as spinels, possess a cubic crystal structure and exhibit excellent mechanical, thermal, and chemical stabilities. MgAl2O4 substrates exhibit optical transmittance over a wide spectral range, from UV to IR, along with low dielectric loss, making them suitable for optical and photonic applications. MgAl2O4 finds widespread usage in bulk acoustic wave and microwave devices and is an excellent substrate material for fast epitaxial growth of III-V nitrides in IC with moderate cost. MgAl2O4 is cleaved on the (100) plane, therefore GaN LD cavities can be obtained by cleaving MgAl2O4 substrates along the (100) direction, which will also work well for ZnO.

Hangzhou Shalom EO provides stock epi-ready MgAl2O4 wafers and custom MgAl2O4 wafers.

Specifications:

Material	MgAl2O4 crystals	Orientation	＜100＞, ＜110＞, ＜111＞
Orientation Error	±0.5°	Maximum Diameter	20mm
Typical Thickness	0.5mm, 1.0mm	Thickness Tolerance	±0.05mm
Size Tolerance	±0.1mm	Surface Finish	SSP or DSP
Roughness	Ra<0.5nm	Cleanness and Package	class 1000 clean room and class 100 bags

Physical Properties:

Crystal Structure	Cubic: a = 8.083 Å	Growth Method	Czochralski
Density	3.64 g/cm3	Melt Point	2130℃
Hardness	8.0 (Mohns)	Thermal Expansion	7.45 (x10-6/℃)
Phase Velocity	6500 m/s at (100> shear wave)	Propagation Loss	6.5 dB/ms
Typical Growth Direction	<100> and <110>	Color	Colorless
Dielectric Constant	8-9		

Product List of MgAl2O4 Substrates

Code	Size	Thickness	Orientation	Surface Finish	Unit Price
644-001	5x5mm	0.5mm	<100>	SSP	Inquire
644-002	5x5mm	0.5mm	<100>	DSP	Inquire
644-003	5x5mm	0.5mm	<110>	SSP	Inquire
644-004	5x5mm	0.5mm	<111>	SSP	Inquire
644-005	10x10mm	0.5mm	<100>	SSP	Inquire
644-006	10x10mm	0.5mm	<100>	DSP	Inquire
644-007	10x10mm	0.5mm	<110>	SSP	Inquire
644-008	10x10mm	0.5mm	<111>	SSP	Inquire
644-009	Φ12.7mm	0.5mm	<100>	SSP	Inquire
644-010	Φ12.7mm	0.5mm	<100>	DSP	Inquire
644-011	Φ25.4mm	0.5mm	<100>	SSP	Inquire
644-012	Φ25.4mm	0.5mm	<100>	DSP	Inquire
644-013	Φ50.8mm	0.5mm	<100>	SSP	Inquire
644-014	Φ50.8mm	0.5mm	<100>	DSP	Inquire

Magnesium Oxide (MgO) Substrates

- Twinless crystal structure, low dielectric constant (9.65), and miniature loss at microwave band
- Maximum Size: 50x50x30mm
- Stocked and custom MgO substrates available
- Orientations:＜100＞,＜110＞ and ＜111＞
- Surface Roughness: Ra < 0.5nm
- Applications: Thin film growth of Ferro-magnetic, Photo-electronic, semiconductor, and high-temperature superconductor (HTSC) applications

MgO (Magnesium Oxide Crystals), due to its low dielectric constant and minimal microwave band loss, along with the availability of large-sized wafers (up to 2 inches in diameter and larger), has emerged as a crucial industrial material for High-Temperature Superconductor (HTS) thin monocrystalline wafers. MgO serves as an exceptional single-crystal substrate catering to various thin film growth tasks including Ferro-magnetic, Photo-electronic, semiconductor, and high-temperature superconductor films. Its utility extends to III to V element research, exploring epitaxial effects on polymer crystallization, and even for depositing ferroelectric coatings on its substrates. Moreover, MgO wafers find increasing applications in Plasma Display Panel (PDP) technology.

Hangzhou Shalom EO provides both stocked standard MgO wafers and custom MgO wafers.

Common Specifications:

Material	MgO crystals	Orientation	＜100＞, ＜110＞, ＜111＞
Orientation Error	±0.5°	Maximum Size	50x50mm
Typical Thickness	0.5mm, 1.0mm	Thickness Tolerance	±0.05mm
Size Tolerance	±0.1mm	Surface Finish	SSP or DSP
Roughness	Ra<0.5nm	Cleanness and Package	class 1000 clean room and class 100 bags

Basic Properties:

Growth Method	Special Arc Melting	Crystallographic Structure	Cubic a = 4.13 Å
Twinning Structure	Twin free	Orientation	<100>, <110>, <111>
Colour	Colourless	Transmission Range	0.2 to 8 μm
Density	3. 585 g/cm3	Melting Point	2780 +/- 20 °C
Thermal Expansion Coefficient	11.2 * 10-6 K-1	Dielectric Constant	9.65
Specific Resistivity	> 1017Ohm/cm		

Product List of MgO Substrates

Code	Size	Thickness	Orientation	Surface Finish	Unit Price
641-001	5x5mm	0.5mm	<100>	SSP	Inquire
641-002	5x5mm	0.5mm	<100>	DSP	Inquire
641-003	5x5mm	0.5mm	<110>	SSP	Inquire
641-004	5x5mm	0.5mm	<111>	SSP	Inquire
641-005	10x10mm	0.5mm	<100>	SSP	Inquire
641-006	10x10mm	0.5mm	<100>	DSP	Inquire
641-007	10x10mm	0.5mm	<110>	SSP	Inquire
641-008	10x10mm	0.5mm	<111>	SSP	Inquire
641-009	Φ12.7mm	0.5mm	<100>	SSP	Inquire
641-010	Φ12.7mm	0.5mm	<100>	DSP	Inquire
641-011	Φ25.4mm	0.5mm	<100>	SSP	Inquire
641-012	Φ25.4mm	0.5mm	<100>	DSP	Inquire
641-013	Φ50.8mm	0.5mm	<100>	SSP	Inquire
641-014	Φ50.8mm	0.5mm	<100>	DSP	Inquire

Substituted GGG (SGG) Single Crystals and Wafers

- Low optical losses (<0.1%/cm) and fine chemical and mechanical properties
- High thermal conductivity (7.4W m-1 K-1) and High laser damage threshold (>1GW/cm2)
- Maximum diameter: 4 inches; typical thickness 0.5/1.0mm
- Clean package: class 1000 clean room and class 100 bags
- Typical orientation of SGGG substrates: ＜111＞
- Applications: liquid phase epitaxy (LPE), magneto-optical film, YIG& BIG film epitaxial growth

GGG, SGGG, and NGG Garnets are used as substrates for liquid phase epitaxy (LPE). GGG substrates are substrates oriented for growing magneto-optical film. GGG substrates are often used to grow the YIG or BIG film placed in a magnetic field, which is an indispensable part of an infrared isolator operating within the 1.3-1.5μm range utilized for optical communication. GGG single crystal substrates of different tangential can achieve the best lattice match with the magneto-optical material, thus ensuring the YIG and BIG film epitaxial growth is successful. SGGG Single-crystal is excellent for growing bismuth-substituted iron garnet epitaxial films.

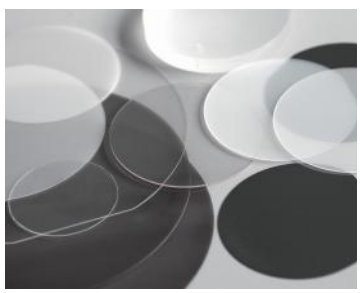
Specifications:

Material	SGGG single crystals	Orientation	＜111＞
Orientation Error	±0.2°	Maximum Diameter	4 inches
Typical Thickness	0.5mm, 1.0mm	Thickness Tolerance	±0.05mm
Size Tolerance	±0.1mm	Surface Finish	SSP or DSP
Roughness	≤1nm	Cleanness and Package	class 1000 clean room and class 100 bags

Material Properties:

Material	SGGG	Chemical Formula	/
Lattice Constant	12.497Å	Growth Method	Czochralski
Density	7.09g/cm3	Mohs Hardness	7.5
Melting Point	1730℃	Refractive Index	1.954@1064nm

SAW Quartz (SiO2) Crystals and Wafers



- Diameters: 3", 4", 5" and 6"
- Crystal ingots, blanks, and customized wafers available
- Surface type: single-side polished/double sides polished
- Curie Temperature and QC Tested
- Applications: fabrication of piezoelectric devices for such as timing frequency control and frequency selection

Quartz crystal, chemical composition SiO2, and alpha quartz are the main ones used for SAW devices. Its melting point is 1750℃. The density is 2.65×103 kg/m3, and the Mohs hardness is 7. SAW-grade Quartz crystal wafers are favorable for Surface Acoustic Wave (SAW) application with remarkable piezoelectric properties. The thermal stability of quartz crystal is one of its most appealing attributes, its piezoelectric coefficient and dielectric coefficient remain almost unchanged at room temperature. In addition, other advantages of quartz crystal include high mechanical strength and quality factor, high rigidity, good dynamic characteristics, no pyroelectric and ferroelectric effect, good insulation, etc.

Quartz crystals are the most representative and common piezoelectric crystals among single crystals. The applications of piezoelectric quartz include resonators, high-frequency oscillators, and filters, and is widely integrated into navigation, remote control, telemetry, electronics, and electric equipment for automatic weapons, supersonic aircraft, missiles, nuclear weapons, electron microscopes, chronographs, etc.

Hangzhou Shalom EO offers Custom SAW grade quartz crystals and wafers, advanced facilities are equipped for crystal growth, wafer cutting, wafer

lapping, wafer polishing, and wafer checking, and all finished products undergo Curie Temp testing and QC inspections. Quartz crystal ingots, crystal blanks, wafer blanks, and polished wafers are available upon customers' request.

Quartz Crystal Specifications:

Materials	both Pure Z and Y bar available	Synthetic Q Value	min 1.8 , 2.4 to 3.0 mil IEC
Etch Channel Density	max 15/cm2 max100/cm2; max300/cm2	Stress	No dark or discolored visible in polarized light
Surface Finishing	#1000, #2000, #3000 , #4000, and Polished std	Angle Tolerance	ZZ': +/-15" +/-30", +/-1' +/-2'
XX'	+/-15 , +/-30'	Cut Type	AT. BT. IT ,SC,....,etc.
Frequency	1Mhz up to 50 Mhz for AT-fundamental	Size for Round Blank	from 3.0 to 15.0 mm dia (with flat)
Size for Wafer	2.0x8.0 (mm)~ 16x16(mm)	SMD Type	2.5x3.0 above at Customer option
Flat	as requested the flat shall be perpendicular to X axis within +/- 10 deg		

Specifications for 3"/4"/5"/6" Quartz Wafers

Specifications for 3"/4"/5"/6" Quartz Wafers				
Wafer Size	3"	4"	5"	6"
Diameter(mm)	76.2	100	125	150
Tolerance (±mm)	0.25	0.5	0.5	0.5
Primary Reference Flat (mm)	22mm or customized	32.5mm or customized	42.5mm or customized	57.5mm or customized
LTV (5x5mm) (μm)	<2	<2	<2	<2
TTV (μm)	<8	<10	<15	<20
Bow (μm)	±20	±25	±40	±40
Warp(μm)	≤30	≤40	≤50	≤50
PLTV (%) (5x5mm)	≥90%	≥90%	≥90%	≥90%
Cutting Angle	AT36/ST42.75/X/Y/Z etc			
Orientation Flat	All available			
Surface Type	Single side polished/Double sides polished			
Polished Side Ra (nm)	≤1			
Back Side Criteria (μm)	General is 0.2-0.5 or as customized			
Edge Rounding	Compliant with SEMI M1.2 Standard/refer to IEC62276			
Appearance	Contamination: None			
	Particles Φ>0.3μm: ≤30			
	Saw Marks, striations: None			
	Scratch: None			
	Cracks, crowsfeet, Saw marks, strains: None			

Basic Properties:

1. Physical Properties of Synthetic Crystal Quartz

Density(g/cm3)	2.65	Melting Point(°C)	1467
Thermal Conductivity, W/(m x K) (T = 25°C)	10.7 (parallel to axis Z) 6.2 (perpendicular to axis Z)	Thermal Conductivity, W/(m x K) (T = 25°C)	7.1 ő 10-6 (parallel to axis Z) 13.2 ő 10-6 (perpendicular to axis Z)
Hardness (Mohs)	7	Specific Heat Capacity, J/(kg x K) (T = 25°C)	710
Specific Heat Capacity, J/(kg x K) (T = 25°C)	4.34 (parallel to axis Z) 4.27 (perpendicular to axis Z)	Young's Modulus (E), GPa	4.34 (parallel to axis Z) 4.27 (perpendicular to axis Z)
Shear Modulus (G), GPa	31.14	Bulk Modulus (K), GPa	36.4
Chemical Stability	insoluble in water	Elastic Coefficients	C11=87 C12=7 C44=58 C13=13 C14=18 C33=106

2. Synthetic Crystal Quartz Refractive Index vs Wavelength

Synthetic Crystal Quartz Refractive Index vs Wavelength								
λ(μm)	n0	ne	λ(μm)	n0	ne	λ(μm)	n0	ne
0.185	1.676	1.690	0.243	1.605	1.617	0.589	1.544	1.553
0.194	1.660	1.673	0.263	1.593	1.604	1.083	1.534	1.543
0.204	1.643	1.656	0.291	1.581	1.591	1.800	1.524	1.532
0.219	1.625	1.637	0.340	1.567	1.577	2.500	1.512	1.520
0.231	1.614	1.626	0.405	1.557	1.567	3.000	1.500	1.507

Silicon (Si) Crystals and Wafers

- High-purity silicon crystals and wafers for semiconductor
- Diameters: 2", 3", 4", 6" and 8" or customized size
- Stocked and custom Si wafers
- Applications: substrates for epitaxial film growth of GaN, semiconductors, electronics, lasers, solar cells, etc.

Semiconductor silicon wafers are often made of high-purity polycrystalline silicon ingots using the CZ Method to grow silicon single-crystal ingots with different resistivities or using the Float Zone method. The Si wafers are manufactured in a controlled and organized manufacturing process that follows: crystal growth, slicing, chamfering/grinding (lapping), surface etching/polishing, cleaning, inspection, packaging, and other processes.

Doping with designed concentrations can be introduced into the silicon crystal lattice to alter its electrical properties and create regions with specific conductivity (n-type or p-type) required for semiconductor devices. Si wafers are also excellent platforms for the deposition of various thin films to achieve specific functions.

Hangzhou Shalom EO offers various grades of Silicon (Si) wafers and substrates, they are used as substrates for GaN (Gallium Nitride) epitaxial film growth, semiconductors, and solar cells.

Specifications:

Orientation	<100>, <110>, <111>	Size(mm)	10×3, 10×5, 10×10, 15×15, 20×15
Thickness	0.5mm, 1.0mm	Size Tolerance	<±0.1mm
Thickness Tolerance	<±0.015mm(special in<±0.005mm)	Polishing	SSP (single surface polished) or DSP (double surface polished)
Redirection Precision	±0.5°	Redirection the Edge	2°(special in 1°)

Basic Properties:

Crystal Structure	M3	Melt Point(℃)	1420
Density(g/cm3)	2.4		
Doping Material	No	b-doped	p-doped
Type	I	P	N
Resistivity	>1000Ωcm	10-3~104Ωcm	10-3~104Ωcm
EPD	≤100/cm2	≤100/cm2	≤100/cm2
O Content (/cm3)	≤1~1.8×1018	≤1~1.8×1018	≤1~1.8×1018
C Content (/cm3)	≤5×1016	≤5×1016	≤5×1016

Silicon Carbide (SiC) Crystals and Wafers

- Wide band gap, several times wider than Silicon
- High thermal conduction and low thermal expansion
- High electric field breakdown voltage and high maximum current density
- Applications: High-frequency power electronic devices, LED solid-state lighting in harsh environments

Silicon Carbide (SiC) single crystal is a semiconductor with the chemical composition of silicon and carbon. Its remarkable thermal conduction, superior mechanical resilience, broad bandgap, and large electric field breakdown strength draw interest in the use of SiC as a semiconductor material. With exceptional hardness and lightweight nature, SiC wafers and substrates serve as robust platforms for the production of high-power, high-frequency electronic components. In comparison to traditional silicon devices, SiC-based power devices boast swifter switching speeds, elevated voltages, diminished parasitic resistances, compact dimensions, and reduced cooling necessities. Its main application areas are high-frequency power electronic devices (Schottky diodes, MOSFET, JFET, BJT, PIN diodes, IGBT), RF transistors, and optoelectronic devices (it is applied in backing material of blue LED).

Hangzhou Shalom EO offers custom SiC crystal wafers, the wafers offer optimum results in LED solid-state lighting and high-frequency devices, in extreme environmental applications such as aerospace, military industry, and nuclear energy.

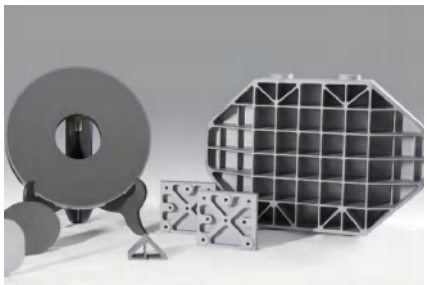
Specifications:

Size	10x3, 10x5, 10x10, 15x15, 20x15, 20x20	dia2" x 0.33mm, dia2" x 0.43mm, dia4"x0.35mm	
Thickness	0.5mm, 1.0mm	Polishing	Single or Double-side Polished
Crystal Orientation	<001>±0.5°	R\Redirection Precision	±0.5°
Redirection the Edge	2°(special in 1°)	Note	Special sizes and orientations are available upon request
Ra:	≤5Å(5μm×5μm)		

Basic Properties:

Growth Method	MOCVD	Crystal Structure	M6
Unit Cell Constant	a=3.08 Å c=15.08 Å	Sequence	ABCACB
Direction	<0001> 3.5°	With Clearance	2.93 eV
Hardness	9.2(mohs)	Heat Travels @300K	5 W/ cm.k
Dielectric Constants	e(11)=e(22)=9.66 e(33)=10.33		

Precision Silicon Carbide (SiC) Ceramics



- Thermal Stability, Outstanding Hardness, Radiation, Corrosion Resistance and Wear Resistance
- Near-Net-Size Molding, Shrinkage Rate Less Than 1% During the Reaction Sintering Process
- Complex Structures Are Realizable
- Good Green Body Machinability, Green Body Accuracy down to 0.1mm
- Excellent Optical Machinability, The Roughness Can Be Better Than 3mm
- Space Radiation Resistance: Resistant to Atomic Oxygen and Radiation

SiC ceramics, or silicon carbide ceramics, are a class of advanced engineering materials renowned for their prominent holistic properties and versatile functions catering to comprehensive industries. Derived from silicon carbide, these ceramics offer exceptional thermal stability, outstanding hardness, corrosion resistance, and wear resistance. Through processes such as hot pressing or sintering, SiC ceramics are crafted to meet the demands of diverse applications including semiconductor, automobile, mechanical and chemical industries, environmental protection, space, satellite, information electronics, etc.

Shalom EO offers precision SiC ceramics manufactured using gel injection molding and densification sintering techniques. Utilizing industrial-leading research results, our state-of-the-art fabrication techniques ensure the provision of high-quality silicon carbide ceramics with the following technical advantages:

1. Near-net-size molding: The product exhibits minimal shrinkage (less than 1%) during the reaction sintering process. This enhances the yield of SiC ceramics with intricate shapes, enabling high-precision manufacturing.
2. Realization of complex structures: Various complicated shapes including semi-closed backs and hollowed-out structures can be achieved, reducing overall weight and accommodating a wider range of application needs.
3. Excellent green body machinability: The intermediate green body stage can be efficiently processed using CNC machining, achieving an accuracy of 0.1mm at best. This significantly reduces the finishing cycle of the sintered body, enhancing efficiency and lowering costs.
4. Superior optical machinability: After optical processing, the surface roughness can be improved to better than 3nm, obtaining high-quality finishes.

Besides, our precision SiC Ceramics have excellent specific stiffness (almost four times the magnitude that of ULE materials) and thermal stability (almost four times the magnitude of Be materials), it is also resistant to space radiation and proton oxygen. These properties ensure that the precision SiC ceramics provide reliable performance in demanding environments.

Specifications:

Densityρ (g/cm3)	3.02	Young's Modulus E (GPa)	345
Thermal Cond. λ (W/ (m·K))	180	CTE α (ppm/K at RT)	2.4
Specific Stability E/ρ	114.24	Thermal Stability λ/α	75

Comparison Chart of SiC Ceramics and Other Materials

Material	Density (g/cm3)	Young's Modulus E(GPa)	Thermal Cond. λ(W/ (m·K)	CTE α (ppm/K at RT)	Specific Stability E/ρ	Thermal Stability λ/α
Preferred Values	Small	Large	Large	Small	Large	Large
Corning Fused Silica	2.2	73	1.4	0.5	33.18	2.8
Corning ULE	2.21	67	1.3	0.015	30.32	86.67
Schott Zerodur	2.53	92	1.46	0.02	36.36	73
Be	1.85	287	216	11.3	155.14	19.12
Shalom EO-SiC Ceramics	3.02	345	180	2.4	114.24	75
6061Aluminum	2.7	68	167	23	25.19	7.26
Single Crystal Silicon	2.33	130	148	2.5	55.79	59.2

Shalom EO also offers products made by SiC ceramics like SiC Mirrors (including Ultra-large-aperture Mirrors, Vibrating Mirrors, Scanning mirrors, and Fast Speed Mirror), Silicon Carbide Structural Components (Monolithic SiC Ceramic Frames, Installation Substrates, etc.), and Precision Silicon Carbide Suction Discs & Substrates for Semiconductors, Integrated Circuits/IGT. Customized requirements and volume manufacturing are both available.

The features of these SIC ceramic-based products are listed below:

1） SiC Mirrors:

Ultra-lightweight:

- back rib thickness 1-3mm
- skeleton structure further reduces weight
- lightweight rate up to 90%; minimum surface density better than 10kg/m2.

Complex structure mirrors:

- skeleton structure to reduce the weight of mirror blanks
- back semi-closed structure to improve the rigidity of mirror blanks
- optical-mechanical integration structure to reduce the weight of the system, reduce the thermal mismatch, and enhance the environmental adaptability.

Vibrating mirrors, scanning mirrors, fast mirrors:

- low rotational moment of inertia
- high resonance frequency; high thermal stability
- non-toxic (a fine substitute for Be)

2） Silicon Carbide Structural Components

Silicon carbide structural components: precision integrated silicon carbide frames, mounting substrates and other types of structural components, used in modern optoelectronic systems, semiconductor manufacturing equipment and other fields

3） Precision silicon carbide suction cups and substrates

- Used in semiconductor manufacturing equipment, integrated circuits/IGBT and other device substrates
- Dense and homogeneous material, good processability
- high surface precision and high form precision

Fused Silica and Optical Quartz Glass Wafers

- Brands: Corning HPFS 7980/7979/7978, JGS1 UV Optical Quartz Glass
- Substrates for semiconductors, micro-electronics, Optical Windows, Optical Mirrors, etc.
- Single Crystal Quartz Wafers and Substrates are also available
- Custom dimensions, shapes, and more
- Maximum Diameter 450mm, Minimum thickness 0.03mm
- Applications: UV applications, Optical and Laser Systems, Spacecrafts, and semiconductors, etc.

Fused Silica and Optical Quartz Glass Wafers or Substrates are thin discs or square plates of variable dimensions or shapes made from Fused Silica or Quartz Glass, which are transparent solids composed of refined SiO2 in amorphous form gained through the rapid cooling of molten Silica.

In general, SiO2 glass variants exhibit a set of unique benefits that make them indispensable in the fabrication of high-tech products. First, it has exceptional thermal properties, quartz glass will not deform at temperatures <1400°C, with the additional virtue of low thermal expansion, and excellent thermal shock resistance. Second, Fused Silica glass is hard and robust. Other advantages of Fused Silica and Optical Quartz Glass include wide UV-IR transmission, chemical inertia, radiation resistance, low refractive indices, and low chromatic dispersion, etc. The application fields of fused silica glass are wide, encompassing optical and laser systems, UV-light sanitation, semiconductors, spacecraft, etc.

Hangzhou Shalom EO offers Fused Silica and Optical Quartz Glass Wafers or Substrates made from glass materials equivalent to the brands stated: Corning HPFS 7980/7979/7978, JGS1(Optical Quartz Glass). Large-size wafers and substrates are available with a maximum diameter of 450mm and smooth surfaces with surface roughness of < 5 Å. All the specifications could be customized at your request.

Specifications:

Brands and Materials:	Corning :Fused silica 7980/7978/7979 etc. Made in China: Fused Silica JGS1, Single Crystal Quartz etc.
Diameters	Up to 450mm(4inch/6inch/8inch/12inch/350mm/450mm)
Thickness	Minimum 30μm(0.1mm/0.2mm/0.3mm/0.5mm/1mm etc)
Dimensional Tolerance	+/- 0.2mm
Thickness Tolerance	+/- 0.1mm
Thickness Variation(TTV)	< 2μm
Surface Roughness (Rz)	< 0.05μm
Surface Quality	40/20 S/D, or custom
Bow/Warp	<20μm
Other customized specifications available	

Material Properties:

Density (at 25°C / 77°F)	2.201 g/cm^3
Shear Modulus	30.6 GPa
Young's Modulus	2.1 GPa
Bulk Modulus	37.4 GPa
Modulus of Rupture, abraded	52.4 MPa
Poisson's Ratio	0.179
Knoop Hardness (100g load)	522 kg/mm^2
Compressive Strength	1.14 GPa
Tensile Strength	54 MPa
Strain Point	893°C/1639.4°F
Thermal Expansion Coefficients	0.52 ppm/K @5-35°C 0.57 ppm/K @0-200°C 0.48 ppm/K @-100 - 200°C
Annealing Point	1042°C/1907.6°F
Softening Point	1585°C/2885°F
Thermal Conductivity	1.38 W/m·K
Thermal Diffusivity	0.0075 cm^2/s
Specific Heat	0.770 J/g·K
Refractive Index	Nd = 1.45840 @589nm
Dielectric Constant	E = 3.8

Note: The parameters presented here are representative of commercially available Fused Silica and are for references only. Please view the data sheets of the brands if you want to check the individual properties of each brand.

Strontium Titanate (SrTiO3) Substrates

- Twinless crystal structure, excellent physical and good mechanical properties
- Maximum diameter: 35mm, typical thickness 0.5 /1.0mm
- Stocked and custom SrTiO3 substrate
- Surface Roughness: Ra < 0.5nm
- Clean package: class 1000 clean room and class 100 bags
- Other applications: epitaxial growth of HTSC and oxide thin films (e.g., YBCO, Bi-system, La-system, etc.), Special optical windows, high-quality sputtering, Magnet Sputtering, Pulsed Laser Deposition (PLD)

Strontium Titanate or SrTiO3 (STO) single crystal has a twinless crystal structure and very good physical and mechanical properties for film growth. STO provides a good lattice match to most materials with Perovskite structure. It is an excellent substrate for epitaxial growth of HTSC (High-Temperature Superconductor) and various oxide thin films. Its lattice constant (3.905Å) matches well with the common high TC superconductive material YBCO (lattice constant 3.88 Å). STO is also a suitable platform for other high TC films such as Bi-system, La-system, and others. SrTiO3 single crystal has been utilized for special optical windows and as a high-quality sputtering target as well. It can also accommodate diverse film growth technologies such as Magnet Sputtering, Pulsed Laser Deposition (PLD), Vaporization, MOCVD, CVD, laser MBE, etc. Films made with these materials and technologies on SrTiO3 wafers exhibit excellent performance.
Hangzhou Shalom EO provides stocked standard SrTiO3 (or STO) wafers and customized wafers.

Specifications:

Materials	SrTiO3 crystals	Orientations	＜100＞, ＜110＞, ＜111＞
Orientation Error	±0.5°	Maximum Diameter	35mm
Typical Thickness	0.5mm, 1.0mm	Thickness Tolerance	±0.05mm
Size Tolerance	±0.1mm	Surface Finish	SSP or DSP
Roughness	Ra<0.5nm	Cleanness and Package	class 1000 clean room, class 100 bags

Basic Properties:

Crystal Structure	M6	Growth Method	Blaze method
Unit Cell Constant	a=3.905Å	Twin Structure	Twin free
Color	Colorless to light yellow	Melt Point（℃）	2080
Density（g/cm3）	5.175（g/cm3）	Hardness	6-6.5（mohs）
Thermal Expansion（/℃）	9.4×10-6	Thermal Conductivity	120 milliwatts/cm °C at 100 °C
Dielectric Constants	ε=300	Chemical Stability	Insoluble in water
Tangent Loss	~5×10-4（300k） ~3×10-4（77k）	Specific Resistivity	> 107Ohm/cm
Transmission Range	0.4 to 6 μm	Refraction Index	nc = 2.380 nd = 2.409 nf = 2.488
Dispersion	(nf - nc) = 0.108		

Product List of SrTiO3 Substrates

Code	Size	Thickness	Orientation	Surface Finish	Unit Price
642-001	5x5mm	0.5mm	<100>	SSP	Inquire
642-002	5x5mm	0.5mm	<100>	DSP	Inquire
642-003	5x5mm	0.5mm	<110>	SSP	Inquire
642-004	5x5mm	0.5mm	<111>	SSP	Inquire
642-005	10x10mm	0.5mm	<100>	SSP	Inquire
642-006	10x10mm	0.5mm	<100>	DSP	Inquire
642-007	10x10mm	0.5mm	<110>	SSP	Inquire
642-008	10x10mm	0.5mm	<111>	SSP	Inquire
642-009	Φ12.7mm	0.5mm	<100>	SSP	Inquire
642-010	Φ12.7mm	0.5mm	<100>	DSP	Inquire
642-011	Φ20mm	0.5mm	<100>	SSP	Inquire
642-012	Φ20mm	0.5mm	<100>	DSP	Inquire
642-013	Φ25.4mm	0.5mm	<100>	SSP	Inquire
642-014	φ25.4mm	0.5mm	<100>	DSP	Inquire

Fe:SrTiO3 Crystals and Substrates

- Similar crystal structure to SrTiO3
- Typical Thickness: 0.5/1.0mm or customized
- Typical Orientations:<100> <110> <111>
- Clean package: class 1000 clean room and class 100 bags
- Single side or double sides polished optional
- Fe concentration (%): 0.05%, 0.04%

Iron Doped Strontium Titanate Crystal Substrate (Fe:STO) is manufactured through adding small amounts of Iron into SrTiO3 lattice. The dielectric and magnetic properties grant Fe-doped SrTiO3 crystal substrate usages in field-effect transistors (FETs), HEMTs, MRAM, magnetic field sensors, etc. Hangzhou Shalom EO provides 0.05%, 0.04% iron doping concentration.

Specifications:

Material	Fe:SrTiO3	Size(mm)	10×3, 10×5, 10×10, 15×15, 20×15
Thickness	0.5mm, 1.0mm	Size Tolerance	<±0.1mm
Thickness Tolerance	<±0.015mm (special requirement can reach <±0.005mm)	Polishing	Single or Double surface polished (SSP or DSP)
Orientations	<100>, <110>, <111>	Redirection Precision	±0.5°
Redirection the Edge	2°(special in 1°)		

Basic Properties:

Crystal Structure	Cubic	Growth Method	Flame Method
Lattice Constant	a=3.905Å	Fe Concentration(%)	0.05%, 0.04%
Melt Point(℃)	2080	Density(g/cm3)	5.122
Hardness(mohs)	6-6.5	Dielectric Constants	ε=5.20
Chemical Stability	Insoluble in Water	Coefficient of Thermal Expansion(/℃)	9.4×10-6
Thermal Expansion Coefficient	10.4×10-6/k	Loss Tangent	~5×10-4(300k) ~3×10-4(77k)

Nb:SrTiO3 Crystals and Substrates

- Different electrical resistivities depending on the Nb doping concentration
- Similar crystal structure to SrTiO3
- Maximum diameters: Φ2.5″
- Clean package: class 1000 clean room and class 100 bags
- Typical Orientation of Nb: SrTiO3 substrates: <100>, <110> and <111>
- Nb Concentration (wt%): 0.1-1.0

Niobium (Nb) doped SrTiO3 (NSTO) single crystal has a similar structure to SrTiO3. NSTO crystals have different electrical resistivities depending on the Nb doping concentration.

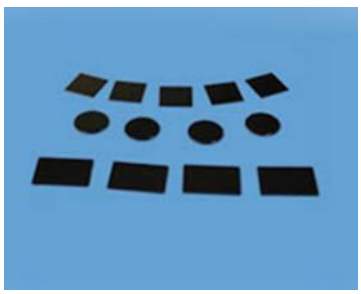
Specifications:

Size	10x3, 10x5, 10x10, 15x15, 20x15, 20x20, Φ15, Φ20, Φ1″, Φ2″, Φ2.6″	Thickness	0.5mm, 1.0mm
Polishing	Single or Double-side Polished	Crystal Orientation	<100> <110> <111>
redirection Precision	±0.5°	Redirection the Edge	2°(special in 1°)
Note	Special size and orientation are available upon request	Ra	≤5Å(5μm×5μm)

Basic Properties :

Nb:SrTiO3	A	B	C	D
Nb Concentration (wt%)	1.0	0.7	0.4	0.1
Resistivity Ohm-cm	0.0035	0.0070	0.05	0.08
Migration Rates cm2/vs	9.0	8.5	8.5	6.5
Characteristics	Nb:SrTiO3 has a similar structure with SrTiO3, but the former has electrical conductivity.			

Nd:SrTiO3 Crystals and Substrates



- Similar crystal structure to SrTiO3
- Thickness:0.5/1.0mm or customized
- Single side or double sides polished optional
- Typical Orientation of Nb:SrTiO3 substrates: <100>, <110> and <111>
- Clean package: class 1000 clean room and class 100 bags
- Nd concentration(%): 0.05

Neodymium-doped Strontium titanate (Nd: SrTiO3) single crystal has a similar structure to SrTiO3 crystal, which matches well with the lattice of perovskite structure materials. We can provide Nd: SrTiO3 single crystal substrate with 0.05% Nd concentration.

Specification:

Material	Nd:SrTiO3	Size(mm)	10×3, 10×5, 10×10, 15×15, 20×15 customized special orientation and size of the substrate is available.
Thickness	0.5mm, 1.0mm	Size Tolerance	<±0.1mm
Thickness Tolerance(mm)	<±0.015mm (special requirement can reach <±0.005mm)	Polishing	Single or Double surface polished (SSP or DSP)
Orientations	<100>, <110>, <111>	Redirection Precision	±0.5°
Redirection the Edge	2°(special in 1°)		

Basic Properties:

Crystal Structure	Cubic	Growth Method	Flame Method
Lattice Constant	a=3.905Å	Nb Concentration(%)	0.05%
Melt Point(℃)	2080	Density(g/cm3)	5.122
Hardness(mohs)	6-6.5	Dielectric Constants	ε=5.20
Chemical Stability	Insoluble in Water	Coefficient of Thermal Expansion(/℃)	9.4×10-6
Thermal Expansion Coefficient	10.4×10-6/k	Loss Tangent	~5×10-4(300k) ~3×10-4(77k)

Terbium Gallium Garnet (TGG) Crystals and Substrates

- Large Verdet constant and low optical loss
- High thermal conduction and laser-damaged threshold
- Excellent for Faraday devices (Rotator and Isolator) in the range of 400nm-1100nm
- Clean package: class 1000 clean room and class 100 bags
- Typical orientation of TGG substrates: ＜111＞
- Applications: Faraday devices, lasers, and optical fiber system

Terbium Gallium Garnet (TGG) single crystal, with large Verdet constant, low optical loss, high thermal conduction, and high laser-damaged threshold, has become an excellent magneto-optical material used to manufacture Faraday devices (Rotator and Isolator) operating in the range of 400nm-1100nm (excluding 470 - 500nm), which finds widespread utilities in YAG, Ti-doped sapphire, multi-stage amplification, Annular, seed injected lasers. Shalom EO provides customized and stocked TGG substrates for magnetic and ferroelectricity film growth.

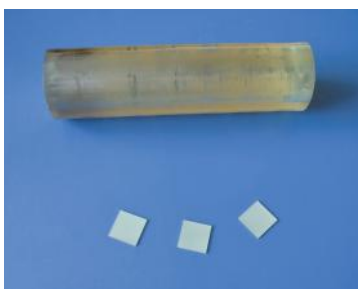
Specification:

Material	TGG(Terbium Gallium Garne) single crystal	Orientations	<111>±5 °
Wavefront Distortion	<λ/8 wave total @633nm	Extinction Ratio	A:>30dB，B:>28dB
Diameter Tolerance	±0.1mm	Length Tolerance	±0.05mm
Chamfer	0.2mm @ 45°	Flatness	<λ/10 wave at 633nm
Parallelism	<1 arc minutes	Perpendicularity	<5 arc minutes
Surface Quality	10/5 S/D per MIL-O13830A		

Basic Properties:

Chemical Formula	Tb3Ga5O12	Crystal Structure	Cubic
Lattice Constant	a=12.355Å	Growth Method	Czochraiski
Density(g/cm3)	7.13	Hardness(mohs)	8.0
Melting Point(℃)	1725℃	Refractive Index	1.954 @1064nm
Thermal Conductivity	9.4×10-6 /K	Verdet Constant	0.12min/Oe.cm at 1064nm

Titanium Dioxide (TiO2) Crystals and Substrates



- Large refractive index and availability of high birefringence
- Fine physical and chemical stability
- Clean package: class 1000 clean room and class 100 bags
- Single side or double sides polished optional
- Applications: Making spectroscope prism and polarizing devices (optoisolator and beam splitter), grow thin films of VO2, CrO2, SnO2, and β-Ga2O3

Single Crystal Titanium Dioxide (TiO2), also known as Rutile, belonging to the Tetragonal structure, lattice constants a = 4.5937 Å, c = 2.9587 Å, TiO2 is often used to grow thin films of VO2, CrO2, SnO2, and β-Ga2O3. TiO2 substrates provide an excellent supportive platform for growing VO2 thin film which would otherwise be difficult to grow. Optical grade rutile titanium dioxide (TiO2) single crystal substrate has large birefringence, a large refractive index, making it a good material for spectral prism and polarizing devices (such as optical isolators and beam splitters). Compared with YVO4, the TiO2 crystals have better physical and chemical stabilities.

Hangzhou Shalom EO offers TiO2 (Titanium dioxide) Crystals and Substrates with orientation error within ±0.5 degrees, and conventional thicknesses of 0.5mm and 1.0mm. These substrates feature a high-precision surface finish with a roughness of Ra<0.5nm, available in both single or double-surface polished versions (SSP or DSP). Should you require further information or have any inquiries about our products, please feel free to reach out.

Specifications:

Materials	TiO2(Titanium dioxide)	Orientation Error	±0.5deg.
Typical Size	5×5×10mm,5×10×10mm,10×10×0.5mm	Typical Thickness	0.5mm, 1.0mm
Thickness Tolerance	±0.05mm	Size Tolerance	±0.1mm
Surface Finish	1	Roughness	Ra<0.5nm
Roughness	Ra<0.5nm	Polishing	Single or Double surface polished (SSP or DSP)

Basic Properties:

Crystal Structure	M4	Lattice Constant	a=4.5937Å c=2.9587Å
Density	4.26(g/cm3)	Melt Point	1870℃
Dielectric Constants	dη/dT：a：-0.72×106 /k c：-0.42×10-6 /k	Linear Expansion Coefficient	a：7.14×106 c：9.19×106
Hardness	7(Mohs)		

YAlO3(YAP) Crystals and Substrates

- Excellent optical performance, physical properties, and chemical properties
- Maximum Diameter: 2 inches, typical thickness 0.5/1.0mm
- Surface Roughness: Ra < 0.5nm
- Clean package: class 1000 clean room and class 100 bags
- Orientation of YAP substrates:＜100＞, ＜010＞ and ＜001＞
- Applications: for High Temperature Superconductor (HTSC) film growth, II-V nitride, and oxide film growth, and lasers

Hangzhou Shalom EO provides Yttrium Orthoaluminate YAlO3(YAP) crystal substrates. With a perovskite-like orthorhombic crystal structure, lattice constant a=5.176 Å, b=5.307 Å, c=7.355 Å, YAP substrate is often used for the growth of high-temperature superconducting (HTS) thin film, II-V nitride, and oxide films. Yttrium Aluminum Oxide (YAP) is a transparent crystal with a wide band gap, making it suitable for applications in the near-infrared (NIR) region. Rare earth and transition-metal ions dopants located in YAP substrates find wide uses for applications in lasers.

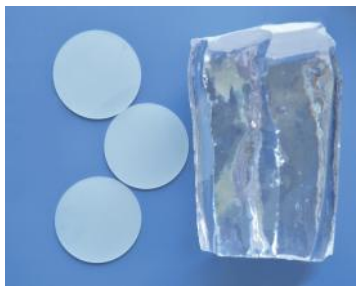
Specifications:

Material	YAlO3 single crystals	Size(mm)	10×3,10×5,10×10,15×15,20×15,20×20 Φ30mm
Thickness	0.5mm, 1.0mm	Crystal Orientation	(100), (010), (001) ±0.5°
Redirection the Edge	2°(special in 1°)	Note	Special sizes and orientations are available upon request
Ra	≤5Å(5μm×5μm)		

Basic Properties:

Crystal Structure	monoclinic	Density	5.37g/cm3
Polishing	Single or Double	Lattice Constant	a=5.176 Å, b=5.307 Å, c=7.355 Å
Melt Point	1870℃	Dielectric Constants	ε 16-20
Thermal Expansion(℃)	2-10×10-6		

Yttria Stabilized Zirconia (YSZ) Crystals and Substrates



- High hardness and high chemical resistance, excellent wear resistance
- Typical thickness 0.5/1.0mm
- Surface Roughness: Ra < 0.5nm
- Clean package: class 1000 clean room and class 100 bags
- Typical Orientation of YSZ substrates: ＜001＞
- Applications: high-temperature superconducting films, thin film growth of single and multiplication oxides, ceramics, refractories, machinery, electronics, optics, and aerospace, etc.

Yttria Stabilized Zirconia (YSZ) single-crystal substrate is manufactured by adding 8-13 mol% Yttrium to the melts of Zirconium Oxide (Zirconia) as stabilizer to prevent the Zirconia from breaking up during the cooling process, Yttria Stabilized Zirconia (YSZ) single crystals feature moderate cost, wear-resistance, and good match with multiple single and multiplication oxides. YSZ was one of the earliest materials used for stabilizing high-temperature superconducting thin films of YBC If using it for optical transmission experiments then get double-side polished versions, otherwise single-side polished is the most common. Exhibiting outstanding physical and chemical properties, Shalom EO's YSZ substrates have versatile functions in various fields, such as ceramics, refractories, machinery, electronics, optics, and aerospace, etc.

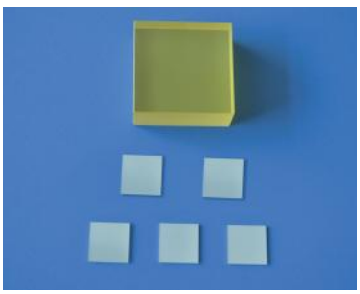
Specifications:

Size(mm)	10x3, 10x5, 10x10, 15x15, 20x15, 20x20, dia2" x 0.33mm dia2" x 0.43mm 15 x 15 mm	Thickness	0.5mm, 1.0mm
Polishing	Single or Double Side Polished	Crystal Orientation	<001>±0.5°
redirection Precision	±0.5°	Redirection the Edge	2°(special in 1°)
Note	Special sizes and orientations are available upon request	Ra	≤5Å(5μm×5μm)

Basic Properties:

Crystal Structure	M3	Growth Method	Skull melting, cold crucible method
Unit Cell Constant	a=5.147 Å	Melt Point(℃)	2700
Density(g/cm3)	6.0	Hardness	8-8.5(mohs)
Purity	99.99%	Thermal Expansion(/℃)	10.3×10-6
Dielectric Constants	ε=27		

Zinc Oxide (ZnO) Crystals and Substrates



- Single side or double sides polished optional
- Fine physical and chemical stability
- Wide bandgap
- Customized substrates and wafers are available
- Applications: wide bandgap semiconductor thin growth, GaN film growth, semiconductor photoelectronic devices, magnetic semiconductors, blue and violet optoelectronics applications

Zinc Oxide (ZnO) crystal substrates are a wide bandgap semiconductor material. As a single crystal semiconductor, the bandgap is in the 3.4 eV range which makes it attractive for manifold blue and violet optoelectronic applications as well as UV devices. The availability of large-size ZnO crystals also gives ZnO a competitive edge over GaN. substrates show a distinguished advantage for the thin film growth Gallium Nitride (GaN). Like GaN, it has a wurtzite structure, with lattice constants well matched to GaN (a=3.249, c=5.205). The lattice mismatch between ZnO and GaN is only ε=0.017. Perhaps the most important attribute is that it is a soft compliant material that is believed to take up the lattice stress in preference to the growing GaN thin film. However, ZnO has the disadvantage that it dissociates in ammonia at temperatures above 600°C.

Hangzhou Shalom EO offers customized high-quality ZnO crystal substrates and wafers.

Specifications:

Material	ZnO single crystal	Size(mm)	25×25×0.5, 10×10×0.5, 10×5×0.5, 5×5×0.5
Orientation	<0001>, <11-20>, <10-10>±0.5°	Polishing	Single or Double surface polished (SSP or DSP)
Transparency Range	0.4-0.6 μm; > 50%@2μm	Surface Roughness	Ra: ≦ 0.5nm

Basic Properties:

Crystal Structure	M6	Lattice Constant	a=3.252Å c=5.313 Å
Density	ε=5.7	Hardness	4(mohs)
Melt Point(℃)	1975	Coefficient of Thermal Expansion	a /6.5 x 10-6 /℃ c /3.7 x 10-6 /℃
Specific Heat(g.m)	0.125 cal	Pyroelectric Constant	1200 mv/k @ 300 ℃
Thermal Conductivity(cm/k)	0.006 cal	Chemical Stability	Insoluble in water

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