





## Opto-electronic products:

### ✚ Magneto optical crystals


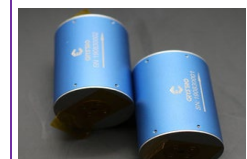
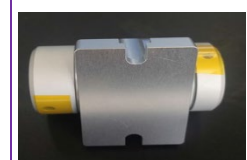

Pictures	Materials / Sizes	Features / Applications
	Terbium gallium garnet ( <b>Tb<sub>3</sub>Ga<sub>5</sub>O<sub>12</sub>, TGG</b> ) is a crucial category of magneto-optical materials for use in the visible and the near-infrared spectral regions (400-470nm and 500-1500nm) Diameter: 4 inches max. (Customized sizes can be 2.8mm, 5mm, 2.3mm)	Large Verdet Constant (Typical 35dB, up to 40dB) Low optical losses (< 0.1%/cm) High thermal conductivity (7.4Wm-1K-1) High laser damage threshold (> 1GW/cm <sup>2</sup> ) Refractive index 1.95 at 1064nm Applications: Faraday rotator, Optical isolator, Magnetic sensor, Free space isolator
	<b>TSAG (Tb<sub>3</sub>Sc<sub>2</sub>Al<sub>3</sub>O<sub>12</sub>)</b> Faraday crystal is an ideal magneto-optical crystal, which is mainly used in the wavelength range of 400-1600nm, namely the visible and infrared bands Diameter: 1-70mm	Large Verdet constant (48 radT-1m-1 at 1064nm), about 20% higher than that of TGG Low absorption (< 3000ppm/cm at 1064nm), about 30% less than that of TGG High power compliant Low thermally-induced birefringence Making the isolator small Applications: Faraday isolator (high power lasers), Imaging applications

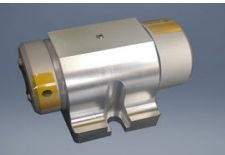
### ✚ Single crystal substrates / Piezoelectric effect crystals

Pictures	Materials / Sizes	Features / Applications
	<b>LSAT (LaAlO<sub>3</sub>)<sub>0.3</sub>(Sr<sub>2</sub>AlTaO<sub>6</sub>)<sub>0.7</sub></b> is a newly developing crystal with perovskite structure and twin-free Size: 2"- 3" dia x 0.5mm; 10x10x0.5mm; 5x5x0.5mm Special size and orientation is available upon request	LSAT has excellent lattice match with high Tc superconductors and many oxide materials LSAT has lower melting point and can be grown by CZ technology at lower cost, therefore, it is expected to replace LaAlO <sub>3</sub> and SrTiO <sub>3</sub> as a common single crystal substrate for epitaxial oxide thin films for gain magnetic ferro-electronic and superconductive devices
	<b>Substituted Gadolinium Gallium Garnet (SGGG)</b> Gadolinium gallium garnet (Gd <sub>3</sub> Ga <sub>5</sub> O <sub>12</sub> or GGG) is a special substrate magneto optical films. In optical communication equipment, a large number of 1.3 and 1.5 micron optical isolators are needed, and the core component is YIG or BIG film placed in the magnetic field Size: Up to 3 inches diameter	Different tangential GGG single crystal substrates can be matched with the lattice of such magneto-optical materials, thus ensuring the successful epitaxial growth of YIG and BIG films The good physical, mechanical and chemical stability of GGG also ensures the requirements of the substrate in the process of film preparation. The substrate material is made of microwave isolator GGG Application: SGGG is used as substrates for liquid epitaxy. It's dedicated substrates for magneto-optical film

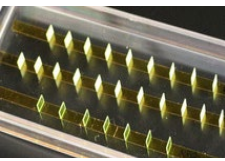

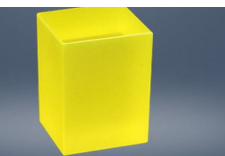
	<p><b>Co<sup>2+</sup>: MgAl<sub>2</sub>O<sub>4</sub> (Co<sup>2+</sup>: Spinel or Co: MALO)</b> crystals is a new material for passive Q-switching in lasers emitting from 1.2 to 1.6μm, in particular, for eye-safe 1.54μm Er: glass laser, but also works at 1.44μm and 1.34μm wavelengths Size as specified: Round, square or flats</p>	<p>High absorption cross section (3.5E-19cm<sup>2</sup>) permits Q-switching of Er: glass laser without intracavity focusing both with flash-lamp and diode-laser pumping. Negligible excited-state absorption results in high contrast of Q-switch, i.e. the ratio of initial (small signal) to saturated absorption is higher than 10</p>
	<p><b>Lanthanum gallium silicate (La<sub>2</sub>Ga<sub>5</sub>SiO<sub>14</sub>)</b> is a phenomenal invention. Though langasite was initially developed as a laser crystal, it revealed a remarkable combination of piezoelectric qualities, which opened up new opportunities to use the LGS crystal in radio frequency devices Sizes: 60mm dia. max.; 70mm length for rod or flats</p>	<p>High damage threshold Good optical rotation Can withstand high and low temperature changes Stable physical and chemical properties High electromechanical coupling coefficient (3 times of quartz) Low equivalent series resistance Applications: Electro-optic Q-switch, SAW device, BAW device, Sensor, High power high repetition rate all solid state laser, High and low temperature change laser</p>
	<p><b>LiNbO<sub>3</sub> (Lithium niobate, LN)</b> crystal is a negative uniaxial crystal and one of the most thoroughly characterized optical materials. With its wide transparency range in the visible and mid-infrared and the excellent chemical and mechanical stability, LN crystal can be used as a birefringent material for applications in infrared <b>SAW Grade Doping Lithium Niobate Wafer MgO Er Fe Doped LT Optical Grade</b> Size: Up to 8 inches diameter</p>	<p>With its large electro-optic coefficients, wide optical transparency window, and availability of high optical quality crystals, LN (lithium niobate) crystal is often the material of choice for optical modulation and Q-switch at near-infrared and infrared wavelengths For electro-optic modulators (EOM) the crystal can be Z-cut with zero residual birefringence along the direction of light propagation or X-cut with non-zero residual birefringence and the maximized effective electro-optic coefficient For Q-switch the crystal is typically Z-cut with zero residual birefringence and an electric field is applied transverse to the direction of light propagation. The piezoelectric ringing in LN is a disadvantage at high repetition frequency, but can be overcome to some extent with proper piezoelectrically damped designs</p>
	<p><b>Gallium Gadolinium Garnet (Gd<sub>3</sub>Ga<sub>5</sub>O<sub>12</sub> or GGG)</b> single crystal substrates is used as substrates for liquid epitaxy growth of YIG or BIG film GGG substrates is dedicated substrates for magneto optical film Size: Up to 4 inches</p>	<p>Low optical loss (&lt; 0.1%/cm), high thermal conductivity (7.4Wm-1K-1) High laser damage threshold (&gt; 1GW/cm<sup>2</sup>) GGG has been successfully applied in the magnetic refrigeration industry in the temperature zone below 20k for market Helium flow and helium-nitrogen liquefaction pre-stage refrigeration</p>
	<p><b>Black amorphous silicon</b> is obtained by the reduction of sand (SiO<sub>2</sub>) with carbon. Ultra-pure crystals of silicon have a blue-grey metallic sheen. Bulk silicon is un-reactive towards oxygen, water and acids (except HF), but dissolves in hot alkalis. Silicon is used in semiconductors, alloys and polymers Size: Up to 8 inches</p>	<p>Doping type: No-doped Resistivity Ω. Cm: 102~104 EPD (cm<sup>-2</sup>): ≤ 100 crystallographic direction: &lt;111&gt;; &lt;100&gt;; &lt;110&gt; ±0.5° Surface: one or two sides polished</p>
	<p><b>Yellow Black Fe<sub>2</sub>O<sub>3</sub> Doped LiTaO<sub>3</sub> Wafer:</b> LiTaO<sub>3</sub> is an E-O crystal widely used for E-O devices, due to its good optical NLO and E-O properties, as well as high damage threshold Sizes: Up to 6 inches diameter</p>	<p>Test results show that the lattice constant increases with the increase of Fe<sub>2</sub>O<sub>3</sub> content. This result indicates a better photorefractive property of Fe: LiTaO<sub>3</sub> than undoped LiTaO<sub>3</sub> Applications: SAW, Q-switch, Light modulator, Sound and light switch, Laser frequency multiplication, Optical parametric oscillator, Optical memory, High temperature and high frequency ultrasonic detector, Infrared detector, Optical pick-up devices</p>

## Faraday isolator

Pictures	Materials / Sizes	Features / Applications
	<b>12mm Aperture 850nm Faraday Optical Isolator High Power</b> An optical isolator is a passive magneto-optic device based on the Faraday effect. It is an optical component that allows the transmission of light in only one direction and prevents unwanted feedback into an optical oscillator. The isolators are based on our own TGG or TSAG Faraday crystals of low loss and high optical power threshold	Superior performance and reliability High isolation / low insertion loss High power models with exit ports for return signal monitoring or beam injection Customized size and wavelength Applications: Seed light amplifying laser, Lock film laser, A semiconductor laser, Optical measuring equipment, Optical parametric oscillator
	<b>SGS OCT System Faraday Rotation Isolator 12mm Aperture</b> Faraday rotator provides non-reciprocal rotation while maintaining linear polarization, The plane of polarization will be rotated 45° when light transmits through the Faraday rotator in the forward direction and rotated additional 45° in the same relative direction with respect to magnetic field when light travels backwards from the reverse direction. It will generate total rotation of 90° and reject the light coming from the reverse direction	Free space input and output Isolators are available for optional $\lambda/2$ plate High damage threshold and power handling Peak isolation: Range from 30dB to 45dB Applications: Laser sensing system, Ultrafast laser system, OCT system, Laser detection
	<b>Free Space Customized Faraday Isolator 3mm - 12mm</b> Our free-space optical isolator (Faraday isolator) and Faraday rotator selection includes a wide range of wavelengths, from 400nm-1064nm, with typical isolation as high as 40dB (single stage), and 75dB (dual stage). We can offer a broadband optical isolator as required also single point wavelength. Most of our optical isolators are available with a choice of low, medium or high power capability	Superior performance and reliability High isolation / low insertion loss High power models with exit ports for return signal monitoring or beam injection Customized size and wavelength Applications: Maintain the light's linear polarization, Avoid deleterious effects of back reflection in laser diodes, Eliminate instability in amplified laser systems caused by ASE, Reduce Nd and Yb oscillations from ASE created by amplifiers
	<b>Durable Ethernet Optical Isolator Optical Fiber Isolator For Laser Systems</b> Our Free Space Isolators could maintain the light's linear polarization, through rotating the plane of polarized light 45° in the forward direction and an additional 45° of non-reciprocal rotation in the reverse direction	Free space input and output Orthogonal isolated beams Isolators are available for optional $\lambda/2$ plate All isolators contain escape ports High damage threshold and power handling Peak isolation: Range from 30dB to 45dB

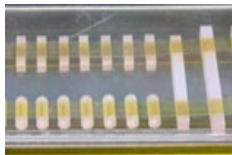


	<p><b>1550nm Faraday Optical Polarization Free Space Isolators</b></p> <p>Polarization Free space isolators are used in the high-speed optical transmitter or other pump laser which need to isolate the backward light. The isolators offer excellent performance with high isolation and low insertion loss. Available in single stage or semi-double stage options are centered at 1310nm, 1490 or 1550nm. The free space isolators can offer a range of clear aperture diameters from 0.40mm to 1.5mm as standard</p>	<p>Superior performance and reliability Customized size and wavelength High isolation / Low insertion loss Low, medium and high power options Applications: Maintain the light's linear polarization, Reduce Nd and Yb oscillations from ASE created by amplifiers, Avoid deleterious effects of back reflection in laser diodes, Eliminate instability in amplified laser systems caused by ASE</p>
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## Scintillation crystals


Pictures	Materials / Sizes	Features / Applications
	<p><b>Ia3d Cerium Doped Yttrium Aluminum Garnet</b> For LED Illumination</p> <p>Cerium doped yttrium-aluminum garnet (Ce: LuAG) is a well established scintillator and has many attractive properties, such as fast decay (80ns), high light yield, emission peaks at 510nm that well matched with the sensitivity of commercial Si-CCD detectors as well as good mechanical and chemical stability</p>	<p>The Ce: LuAG is also a very appropriate crystal for imaging screens, LED lighting and laser lighting</p>
	<p><b>Ce Doped Gadolinium Aluminum Gallium Garnet Ce GAGG Single Crystal</b></p> <p>GAGG (Ce) - Gadolinium Aluminum Gallium Garnet (<math>Gd_3Al_2Ga_3O_{12}</math>), doped with Ce is a newly developed scintillator. It is one of the brightest available scintillators with an emission peak at 520nm. GAGG (Ce) has good stopping power, is physically rugged and well suited to a broad range of applications</p>	<p>Good absorbers with good stopping powers - density 6.63g/cm<sup>3</sup> Robust with good mechanical characteristics Applications: Medical imaging - PET, PEM, SPECT and CT Specialist applications in high energy, nuclear, space and medical physics</p>
	<p><b>Single Photon Emission Computed Tomography Spect High Thermal Conductivity Gagg Crystal</b></p> <p>Ce: GAGG crystal exhibits stable physical and chemical properties, high thermal conductivity, and resistance to harsh environments. It exhibits excellent scintillating performance, for example, high scintillating efficiency, high light yield, and fast decay time. Ce: GAGG crystals are widely used in photomultiplier tubes, photoelectric counters, scintillation</p>	<p>Because of the excellent scintillation performance of Ce: YAG crystal, it is widely used in CT, scanning electron microscope SEM and other equipment In particular, the linear response of GAGG crystals to gamma rays indicates that Ce: GAGG crystals are a promising medical imaging technology, such as X-ray photography, X-ray computed tomography (CT), and positron emission tomography (PET)</p>

	screens, and other devices. And used in high-energy particle detection and other fields, such as beta rays, gamma rays	
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## ✚ Laser crystals

Pictures	Materials / Sizes	Features / Applications
	<b>Neodymium-Doped Yttrium Aluminum Garnet NdYAG Crystal</b> For Laser Marking Nd: YAG lasers are used in manufacturing for engraving, etching, or marking a variety of metals and plastics, or for metal surface enhancement processes like laser peening. They are extensively used in manufacturing for cutting and welding steel, semiconductors and various alloys	High gain; Low threshold; High efficiency Low loss at 1064nm High optical quality Good thermal conductivity and shock characteristics Applicable to many laser working modes (continuous, pulse, Q-switch, mode lock) Nd: YAG lasers are also employed to make subsurface markings in transparent materials such as glass or acrylic glass and in white and transparent polycarbonate for identity documents
	<b>Holmium Doped Yttrium Aluminum Garnet Ho YAG Laser Crystal 2100nm Wavelength</b> Ho: YAG (Holmium-doped Yttrium aluminum garnet, Ho: $Y_3Al_5O_{12}$ ) is commonly used as an efficient means to generate 2.1 $\mu$ m laser emission from the 5I7 - 5I8 transition	High laser gain; Low quantum defect; Long fluorescence life Large emission cross-section; High slope efficiency High-energy storage capability Applications such as laser remote sensing, medical surgery, and pumping Mid-IR OPO's to achieve 3-5micron emission. Ho: YAG laser can be pumped directly by diode lasers or by Tm-doped fiber lasers, with high slope efficiencies
	<b>AR Coating Passive Q Switches Cr4+ Yag Laser Rod</b> For Beauty Laser Machine Cr4+: YAG crystals have several advantages when compared to traditional passive Q-switching choices such as organic dyes and color centres materials. Cr4+: YAG is chemically stable, UV resistant and it is durable. Cr4+: YAG will operate over a wide range of temperatures and conditions	High damage threshold of 500-1000MW/cm <sup>2</sup> High chemical stability and reliability Long life time and good thermal conductivity Compact passive Q-Switch Being easy to be operated Application: Passively Q-switched lasers for laser rangefinders, LIDAR and LIBS systems, Laser systems where short pulses are required

## ✚ Pockels cell Q switch


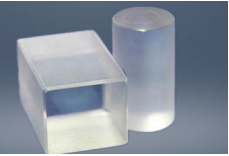

Pictures	Materials / Sizes	Features / Applications
	<b>LGS Series Electro - Optic Pockel Cell Q Switch Active NLO Material</b> A new kind of EO Q-switch is designed by use of a $La_3Ga_5SiQ_{14}$ (LGS) crystal. LGS crystal is one kind of optically active NLO material with very high damage threshold (about 9 times as that of LN), excellent E-O	LGS -based Q-switch (Pockels cell); For wavelengths up to 3.2 $\mu$ m; Transmitted wave front distortion: < 1/4; Damage threshold: > 900MW/cm <sup>2</sup> (@1064nm, 10ns, typical, not guaranteed);




	coefficient, high temperature stability (better than quartz), the Q-switch is based on the consideration that the total rotation angle of the polarization plane is zero, whereas the polarized wave propagates through the Pockels cell back and forth, with the polarization plane gyration and electro-optic effect existing simultaneously, therefore it is widely used in E-O components such as E-O modulator, Q-switch, etc.	LGS available for medium power systems, partially take place of DKDP and LiNbO <sub>3</sub> series Q-switches The LGS (LG-EO-Q) series Q-switch (Pockels Cell) is a practical electro-optic device that can be used in medium output energy lasers to partially take the place of DKDP and LiNbO <sub>3</sub> series Q-switches
	<b>SGS Single Crystal BBO Pockels Cells UV Transmission Low Acoustic Noise</b> BBO is one of the electro-optic material choices for high average power E-O Q switch applications. BBO has significant advantages over other materials in terms of laser power handling abilities, temperature stability, and substantial freedom from piezoelectric ringing. Because it relies on the electro optic effect, switching time - aided by the low capacitance of the E-O Q switch is very fast	High repetition rate High peak power damage resistance Low absorption UV transmission Low acoustic noise The wide transparency range of BBO allows it to be used in diverse applications
	<b>1064nm Single Crystal BBO NLO Pockels Cell Q Switch for Cavity Dumping</b> Beta Barium Borate (BBO) crystal is a Nonlinear Optical Crystal with a combination of unique features: wide transparency region, broad phase-matching range, large nonlinear coefficient, high damage threshold, wide thermal acceptance bandwidth and high optical homogeneity	These Pockels cell have different functions to meet different needs of customers in various fields High repetition rate DPSS Q-switch High repetition rate regenerative amplifier control Cavity dumping Beam chopper
	<b>1064nm DKDP Pockels Cell Q Switch High Damage Threshold</b> The DKDP crystal is a uniaxial crystal with excellent optical quality with an extinction ratio of > 2000:1 (measured using a 632nm He-Ne laser) with a wave front distortion of 98%. The DKDP electro-optic Q-switching capacitor is small (about 3-5pF), so the rise time is short (< 0.5ns), and a narrow pulse width pulse laser can be output during Q-switching. Compared with the widely used electro-optic crystals on the market, DKDP crystals have higher damage thresholds; the damage threshold is > 1GW/cm <sup>2</sup> under optical conditions of 10ns pulse width, 1064nm wavelength and repetition frequency 10Hz	High deuteration (> 98%) DKDP; No static birefringence No photorefractive damage; Resistant to environmental temperature Sealant and adhesive free; High extinction ratio High damage threshold; Low $\lambda/4$ Voltage; Single pass optical transmission Applications: Laser systems with large caliber, high power and narrow pulse width. They are among the optimal E-O Q-switches used in pulse laser systems, including: OEM laser systems; Medical/cosmetic lasers; Versatile R&D laser platforms; Military & aerospace laser systems

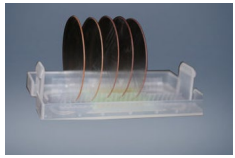
#### Other single crystals

Pictures	Materials / Sizes	Features / Applications
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	<b>6.0g/Cm3 Colorless Laser Grade Tellurium Dioxide TeO<sub>2</sub> Crystal</b> Tellurium Dioxide Crystal (TeO <sub>2</sub> ) is one of the best Acousto-Optic crystals even grown, and extensively used in AO modulators, deflectors, AO tunable filters (AOTFs), laser Q-switches, RF spectrum analyzers	Laser-grade TeO <sub>2</sub> raw material Strict quality control Very competitive prices
	<b>2.355g/cm3 DKDP NLO Crystals Potassium Dihydrogen Phosphat For Q Switch</b> Good UV transmission KDP crystal NLO crystals for Q switch Potassium Dihydrogen Phosphate, known as KDP crystal (KH <sub>2</sub> PO <sub>4</sub> ), and its isomorphic crystals, deuterated KDP, known as KD*P or DKDP crystal (KD <sub>2</sub> PO <sub>4</sub> ), Ammonium Dihydrogen Phosphate, known as ADP crystal (NH <sub>4</sub> H <sub>2</sub> PO <sub>4</sub> ) are widely used in frequency doubling, frequency tripling and frequency quadrupling of Nd-doped laser systems, as well as the electro-optical modulators. DKDP is mainly used in Pockels Cells, and ADP is also used in Acousto-Optical devices	Good UV transmission High optical damage threshold High birefringence High nonlinear coefficients Applications: Laser frequency conversion - harmonic generation for high pulse energy, Electro-optical modulation, Q-switching crystal for pockels cells
	<b>BBO Barium Borate Crystal Dien Laser Nonlinear BaB<sub>2</sub>O<sub>4</sub> Wide transparency</b> BBO is very good for tunable laser sources, such as ultrafast Ti: Sapphire or dye lasers. And it is also widely used for SHG, 3HG, 4HG, and autocorrelation of femtosecond and picosecond Ti: Sapphire lasers; SHG, 3HG, 4HG, 5HG of YAG lasers at 1064nm and 1320nm to yield output of 212-660nm; SHG of tunable dye or solid-state laser sources from 410-750nm to yield output of 205-375nm, SFM of dye laser and YAG harmonics to yield output of 189-400nm	High damage threshold Large nonlinear optical coefficients Wide transparency ranges Wide phase matching ranges DFM (difference-frequency mixing) from the visible to the IR range up to over 3000nm; OPO pumped with SHG or 3HG of YAG or Ti: Sapphire with an output range of 400-3000; Intracavity SHG of Argon ion lasers (488, 514nm) or Copper vapor lasers (510nm, 578nm)

#### ✚ LaAlO<sub>3</sub> crystals and wafers

Pictures	Materials / Sizes	Features / Applications
	<b>Square &lt;100&gt; Low Microwave Loss Optical Substrate Lanthanum Aluminate LaAlO<sub>3</sub> Target</b> LaAlO <sub>3</sub> is a high temperature superconducting single crystal substrate. It is a good substrate material for epitaxial growth of high temperature superconducting thin films and giant magnetic thin films. Its dielectric properties are suitable for low loss microwave and dielectric resonance applications	Good lattice match to most materials with Perovskite structure Low dielectric constant Low microwave loss Applications: High temperature superconductors, Magnetic and ferro-electric thin films, Low loss microwave, Dielectric resonance



#### **Good Thermal Stability Optical Substrate Single Crystal LaO**

$\text{LaAlO}_3$  is a high temperature superconducting single crystal substrate. It is a good substrate material for epitaxial growth of high temperature superconducting thin films and giant magnetic thin films. Its dielectric properties are suitable for low loss microwave and dielectric resonance applications

Small dielectric constant; Low dielectric loss; Good lattice matching;  
Small thermal expansion coefficient; Good chemical stability;  
Wide energy gap; Large specific surface area; Certain activity;  
Applications: Electronic devices, Catalysis, High temperature fuel cell, Ceramics, Sewage treatment, Substrate materials