SinoCeramics

Optical Components:

Other Crystals

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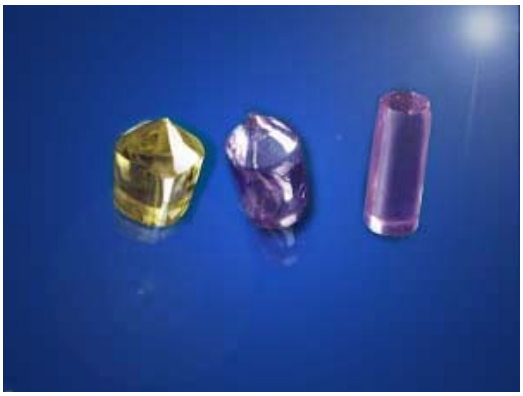
YVO_4 Crystal

The yttrium vanadate (YVO_4) is a positive uniaxial crystal crown with Czochralski method. It has good mechanical and physical properties and is ideal for optical polarizing components because of its wide transparency range and large birefringence. It is an excellent synthetic substitute for Calcite ($CaCO_3$) and Rutile ($TiO2_2$) crystals in many applications including fiber optic isolators, circulators, beam displacers, and other polarizing optics, etc.



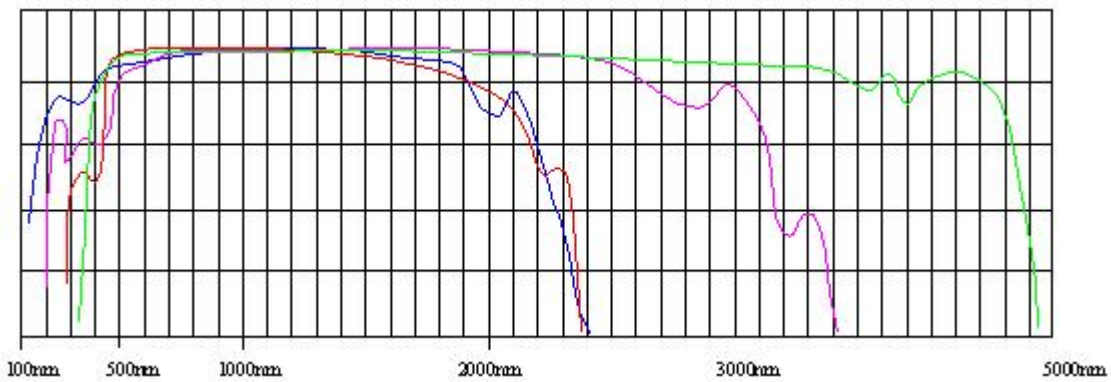
Basic Performance for YVO_4 Crystals

Transmission Range:	0.4-5.0μm		
Crystal Cell:	a = b = 7.12A , c = 6.29A		
Density:	4.22g/cm^3		
Mohs Hardness	5 , like glass		
Thermal Expansion Coefficient:	$a_a = 4.43x10^{-6}/K$	$a_a = 11.37x10^{-6}/K$	
Thermal Conductivity Coefficient:	up C: 5.23W/m/K	°C C:5.10W/m/K	
Thermal Optical Coefficient:	$dn_a/dT = 8.5x10^{-6}/K$	$dn_c/dT = 3.0x10^{-6}/K$	
Refractive Index, Birefringence Walk-Off Angle @ 45°(ρ)	$n_o = 1.9929$ $n_o = 1.9500$ $n_o = 1.9447$	$n_e = 2.2154$ $n_e = 2.1554$ $n_e = 2.2486$	ρ = 6.04° @ 0.63μm ρ = 5.72° @ 1.31μm ρ = 5.69° @ 1.55μm

Sellmeir Equations for Pure YVO4 Crystal:

$n_o^2 = 3.77834 + 0.069736 / (\lambda^2 - 0.04724) - 0.0108133\lambda^2$

$n_e^2 = 4.59905 + 0.110534 / (\lambda^2 - 0.04813) - 0.0122676\lambda^2$

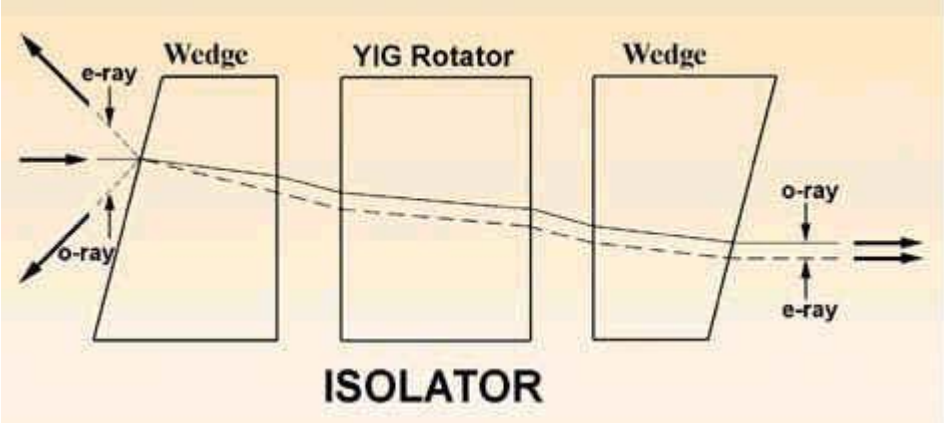


Curve for YVO_4 and LN, Calcite and a-BBO

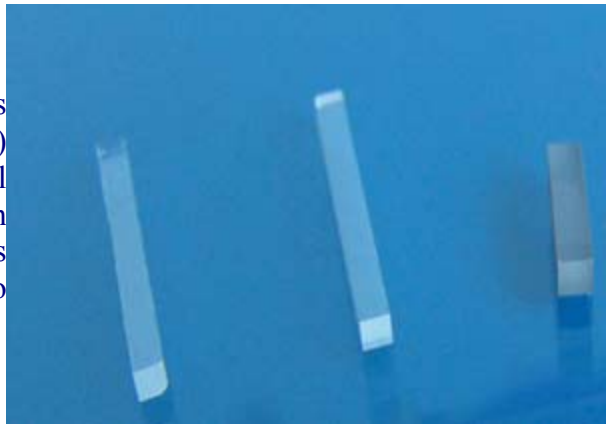
Comparision with Other Birefringent Crystals

- Compared with Calcite, YVO_4 has better temperature stability, physical and mechanical properties.
- Compared with Rutile (TiO_2), YVO_4 has lower Mohs hardness, it is easy to be manufactured for high surface quality of components, that is base for mass production.
- Compared with $LiNbO_3$, YVO_4 has more than three times birefringence than it, that makes your systems become more compact.

Sinoceramics provides crystal wedges based on a crystal's birefringent property to control and isolate the back light transmission in fiber. As shown in the figure below, two birefringent wedges are used together with a YIG rotator to construct the core of a fiber optic isolator.

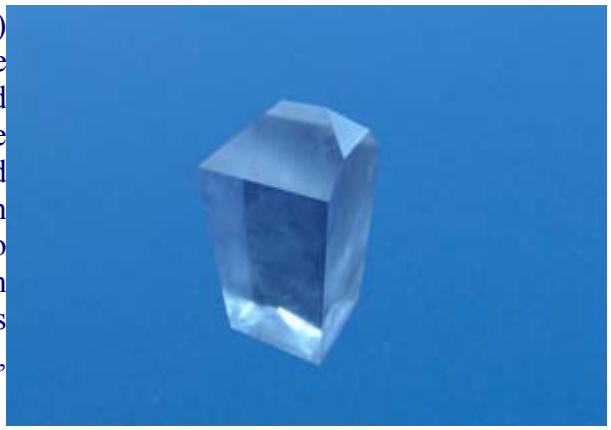


Sinoceramics manufactures (currently mass produces) birefringent wedges for optical fiber communication with. High isolation and low insertion loss can help our customer to produce high quality isolators.



KDP and KD*P

Potassium Dihydrogen Phosphate (KDP) and Potassium Dideuterium Phosphate (KD*P) are among the most widely-used commercial NLO materials. They are commonly used for doubling, tripling and quadrupling of Nd:YAG laser at the room temperature. In addition, they are also excellent electro-optic crystals with high electro-optic coefficients, widely used as electro-optical modulators, Q-switches, and Pockels Cells, etc.



- Good UV transmission
- High optical damage threshold
- High birefringence high nonlinear coefficients

Physical and Optical Properties

.	KDP		KD*P	
Chemical Formula	KH_2PO_4		KD_2PO_4	
Crystal Structure	Tetragonal		Teragonal	
Transmission Range	200-1500nm		200-1600nm	
Nonlinear Coefficients	d_{36} = 0.44pm/v		d_{36} = 0.04pm/v	
Refractive Indicies (@ 1064nm)	n_o = 1.4938	n_e = 1.4599	n_o = 1.4938	n_e = 1.4599
Electro-Optical Coefficients	r_{41} = 8.8pm/v	r_{63} = 10.3pm/v	r_{43} = 8.8pm/v	r_{63} = 25pm/v
Longitudinal Half-Wave Voltage	V_p = 7.56KV (1 = 546nm)		V_p = 2.98KV (1 = 546nm)	
Absorption	0.07/cm		0.006/cm	
Temperature Synchronism Width	11.5°C·cm		7.4°C·cm	
Spectral Synchronism Width	106°·cm		32°·cm	
Angle Synchronism Width	0.84mrad·cm		0.94mrad·cm	
Absorption Coefficient , cm^{-1}	0.07		0.006	
Mohs Hardness	2.5		2.5	
Optical Damage Threshold	> $5GW/cm^2$		> $3GW/cm^2$	
Extinction Ratio	.		30dB	

Sellmeir Equations for KDP:

$$n_o^2 = 2.259276 + 0.01008956 / (\lambda^2 - 0.012942625) + 13.005522\lambda^2 / (\lambda^2 - 400)$$
$$n_e^2 = 2.132668 + 0.008637494 / (\lambda^2 - 0.012281043) + 3.2279924\lambda^2 / (\lambda^2 - 400)$$

Sellmeir Equations for KD*P:

$$n_o^2 = 1.9575544 + 0.2901391 / (\lambda^2 - 0.0281399) - 0.02824391\lambda^2 + 0.0049778261\lambda^4$$
$$n_e^2 = 1.5005779 + 0.6276034 / (\lambda^2 - 0.0131558) - 0.01054063\lambda^2 + 0.0022438211\lambda^4$$

Application:

- Second, third, and fourth harmonic generation of Nd:lasers
- Frequency doubling of dyer laser
- High power laser frequency conversion materials
- Shutter for high speed photography
- Electro-optical modulator and Q switches

KD*P Single Crystal Standards			
Designation	**Operation**	**Input**	**Output**
53.7°	SHG (II)	1064nm	532nm
59.5°	THG (II)	1064nm + 532nm	355nm
63.7°	SFM (II)	1064nm + (421-1000nm)	302 - 515nm
86°	FHG (I) angle tune	532nm	266nm
90°	FHG (I) temperature tune	532nm	266nm
36.6°	SHG (I)	1064nm	362nm
46.8°	THG (I)	1064nm + 352nm	355nm

KDP and KD*P Specifications

Wavefront Distortion:	< 8 @ 633nm
Dimension Tolerance:	(W ± 0.1mm)x(H ± 0.1mm)x(L +0.2mm/ -0.1mm)
Clear Aperture:	> 90% central area
Flatness:	λ /8 @633nm
Surface Quality:	10/5 to MIL-O-13830A
Parallelism:	Better than 20 arc seconds
Perpendicularity:	5 arc minutes
Angle Tolerance:	$\Delta\theta < 0.3°$, $\Delta\varphi < 0.3°$
Quality Warranty Period:	One year under proper use

BSO and BGO

$Bi_{12}SiO_{20}$ (BSO, Bismuth Silicate) and $Bi_{12}GeO_{20}$ (BGO, Bismuth Germanite) single crystals are grown by the Czochralski method. The crystals have been widely used in Photorefractive, photoconductive, electro-optic, acousto-optic applications such as two-wave mixing, four-wave mixing, phase conjugation, real-time interferometry, optical date storage, surface acoustic devices, and electro-optic devices.

Basic Properties

Crystal	$Bi_{12}SiO_{20}$ (BSO)	$Bi_{12}GeO_{20}$ (BGO)
Symmetry	Cubic , 23	Cubic , 23
Melting Point	900°C	930°C
Density	9.2g/cm^3	9.2g/cm^3
Mohs Hardness	4.5	4.5
Transparency Range	450-7500nm	70-7500nm
Transmittance @ 633nm	69%	67%
Refractive Index @ 633nm	2.54	2.55
Dielectric Constant	56	40
Electro-Optic Coefficient	r_{41} = 5x10^{-12} m/V	r_{41} = 3x10^{-12} m/V
Resistivity	5x10^{11}Ω·cm	8x10^{11}Ω·cm
Loss Tangent	0.0015	0.0035

Specifications

Polishing:	2 faces or 6 faces
Flatness:	< λ /8 @ 633nm
Wavefront Distortion:	< λ /4 @ 633nm
Parallelism:	< 30"
Surface Quality:	20/10 to MIL-O-13830A

Sinoceramics provides large sizes of BSO and BGO along with high quality. We provide as-cut and polished BSO and BGO crystals and <110> and <001> cut wafers. The size and orientation can be changed upon request by our customers.

Solid State Laser Solution with Crystals

Sinoceramics provides many kinds of crystals and optical components for solid-state laser applications, including 1064nm, green laser (532nm), blue laser (473nm), 355nm, etc. We supply a range of products from laser crystals, to NLO crystals, to mirrors, to output couplers, to polarizers to assemblies.

Laser Type	Solution	Power mW/cm^2
1064nm laser (pulse)	Nd:YAG + Cr:YAG + Mirrors	0.1-3.0J
1064nm laser (CW)	Nd:YVO_4 + Mirrors	50mW-1W
Green laser	Nd:YVO_4 + LBO + Mirrors	10-500mW
	Nd:YVO_4 + BBO + Mirrors	10-500mW
	Nd:YVO_4 + KTP + Mirrors	1-100mW
Blue laser	Nd:YAG + BiBO + Mirrors	1-100mW