

YVO₄

Yttrium Vanadate (or orthovanadate, YVO₄) is a positive uniaxial crystal. It has very good mechanical, temperature stability and physical properties, and is ideal for optical polarizing components due to its wide transparency range and large birefringence. It is applied for fiber optic isolators and circulators, beam displacers and other polarizing optics, etc.



Basic Properties

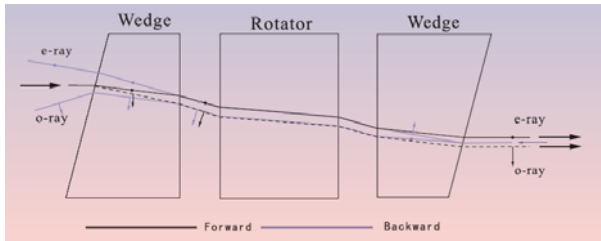
Crystal Structure	Zircon Tetragonal, Space group D _{4h}
Transparency Range	High transmittance from 400 to 5000 nm
Lattice Parameters	a=b=7.12Å, c=6.29Å
Mohs Hardness	~5 (Glass - like)
Atomic Density	1.26x10 ²⁰ atoms/cm ³ (Nd 1.0at%)
Density	4.22 g/cm ³
Melting Point	~1700°C
Thermal Expansion Coefficient	$\alpha_a = \alpha_b = 4.43 \times 10^{-6} /K$; $\alpha_c = 11.37 \times 10^{-6} /K$
Thermal Conductivity	//C: 523W/m/K, \perp C: 5.10W/m/K
Hygroscopic Susceptibility	Non-hygroscopic
Crystal Class	Positive uniaxial, n _o =n _a =n _b , n _e =n _c
Sellmeier Equation (λ in μ m)	$n_o^2 = 3.77834 + 0.069736/(\lambda^2 - 0.04724) - 0.0108133\lambda^2$ $n_e^2 = 4.59905 + 0.110534/(\lambda^2 - 0.04813) - 0.0122676\lambda^2$
Refractive Indices	n _o = 1.9500, n _e = 2.1554 @ 1300 nm n _o = 1.9447, n _e = 2.1486 @ 1550 nm
Birefringence ($\Delta n = n_o - n_e$)	$\Delta n = 0.2054$ @ 1300nm, $\Delta n = 0.2039$ @ 1550 nm
Walk-off Angle at 45°C	$\rho = 5.72^\circ$ @ 1300 nm, $\rho = 5.69^\circ$ @ 1550 nm
Thermal Optical Coefficient	$dn_o/dT = 8.5 \times 10^{-6}/^\circ C$; $dn_c/dT = 3.0 \times 10^{-6}/^\circ C$

Comparison of basic properties between YVO₄ and Other Birefringent Crystals

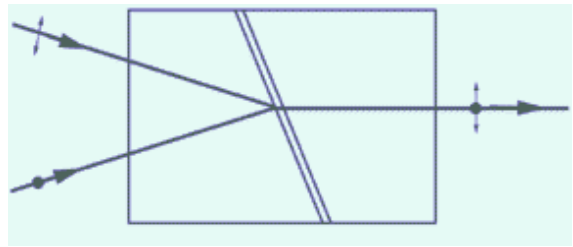
Crystals		YVO ₄	LiNbO ₃	TiO ₂	CaCO ₃
Thermal Expansion (/°C)	c-axis	11.4x10 ⁻⁶	16.7x10 ⁻⁶	9.2x10 ⁻⁶	26.3x10 ⁻⁶
	a-axis	4.4x10 ⁻⁶	2x10 ⁻⁶	7.1x10 ⁻⁶	5.4x10 ⁻⁶
Refractive Indices	n _o	1.9447 @1550nm	2.2151 @1440nm	2.454 @1530nm	1.6346 @1497nm
	n _e	2.1486 @1550nm	2.1413 @1440nm	2.710 @1530nm	1.4774 @1497nm
Birefringence ($\Delta n = n_o - n_e$)		0.2039 @1550nm	-0.0738 @440nm)	0.256 @1530nm	-0.1572 @1497nm
Mohs Hardness		4~5	5	6.5	3
Transparency range		0.4-5 μ m	0.4-5 μ m	0.4-5 μ m	0.35-2.3 μ m

Applications of YVO₄ crystal

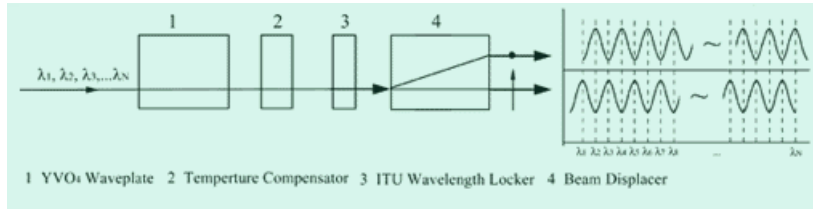
AOTK can provide large quantity (more than 30,000 pcs/month) of YVO₄ displacers and wedges applied for fiber optical **Circulator** and **Isolator** with high quality and low price.



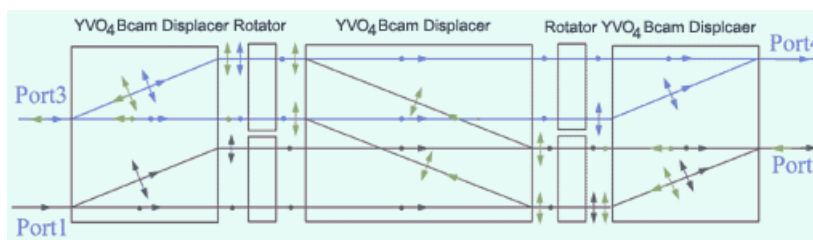
Isolator



PBC



Interleaver

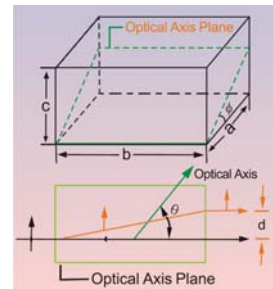


Circulator

YVO₄ Beam Displacer

Specifications

Dimension Tolerance	$(\pm 0.05) \times (\pm 0.05) \times (+0.0/-0.1)$ mm
Optical Axis Orientation	$\pm 0.2^\circ$
Flatness	$< \lambda/10$ @ 632.8 nm
Perpendicularity	< 10 arc min
Parallelism:	< 15 arc sec
Surface Quality	10/5 Scratch/Dig MIL-O-13830A
AR-coating	$R < 0.20\%$ @1550 nm or 1310 nm ± 40 nm



Standard Size

Part No.	Crystal	Size (mm)	θ	ϕ	d	AR-Coating
YBD1011	YVO ₄	2.0x2.0x4.0	45°	0°	0.4 mm	1550 nm
YBD1012	YVO ₄	2.0x2.0x6.0	45°	0°	0.6 mm	1550 nm
YBD1013	YVO ₄	2.0x2.0x7.0	45°	0°	0.7 mm	1550 nm
YBD1014	YVO ₄	2.0x2.0x10.0	45°	0°	1.0 mm	1550 nm
YBD1021	YVO ₄	2.0x2.0x4.0	45°	45°	0.4 mm	1550 nm
YBD1022	YVO ₄	2.0x2.0x6.0	45°	45°	0.6 mm	1550 nm
YBD1023	YVO ₄	2.0x2.0x7.0	45°	45°	0.7 mm	1550 nm
YBD1024	YVO ₄	2.0x2.0x10.0	45°	45°	1.0 mm	1550 nm

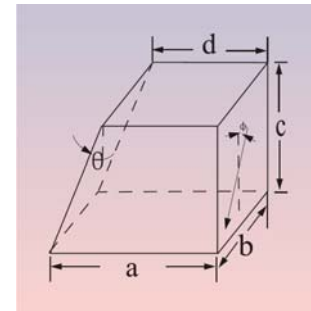
Note: Other sizes and specifications are available upon request.

Birefringent Wedge

AOTK provides crystal wedges based on crystal's birefringent property to control and isolate the back light transmission in fiber optical isolators. Two birefringent wedges are used together with a rotator to construct the core of a fiber optic isolator. As show in the following illustrate:

Speciflcations

Crystal	YVO ₄
Aperture	1.0x1.0 mm ² to 2.0x2.0 mm ²
Dimension Tolerance	± 0.05 mm
Wedge Angle Tolerance	± 15%
Optical Axis rientation	± 0.2°
Flatness	< λ/10 @ 632.8 nm
Surface Quality	10/5 Scratch/Dig
AR-Coating	R<0.2% @1550 nm or 1310 nm ± 40 nm



Standard Size

Part No.	Crystal	a	b	c	θ	φ	AR-Coating
BWG2031	YVO ₄	0.5mm	1.25mm	1.25mm	9.5°	0°	1550 nm
BWG2032	YVO ₄	0.5mm	1.25mm	1.25mm	9.5°	90°	1550 nm
BWG2033	YVO ₄	0.5mm	1.4mm	1.4mm	9.5°	45°	1550 nm
BWG2034	YVO ₄	0.5mm	1.4mm	1.4mm	9.5°	45°	1550 nm
BWG2041	YVO ₄	0.5mm	1.25mm	1.25mm	9.5°	0°	1310 nm
BWG2042	YVO ₄	0.5mm	1.25mm	1.25mm	9.5°	90°	1310 nm
BWG2043	YVO ₄	0.5mm	1.4mm	1.4mm	9.5°	45°	1310 nm
BWG2044	YVO ₄	0.5mm	1.4mm	1.4mm	9.5°	45°	1310 nm

● **Note:** Other sizes and specifications are available upon request.

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α - BBO

α -BBO (High Temperature form BBO) is a negative uniaxial crystal. It has large birefringence over the broad transparent range from 189 nm to 3500 nm. The physical, chemical, thermal and optical properties of α -BBO crystal are similar to those of β -BBO. α -BBO is an excellent crystal to replace Calcite, TiO_2 , and LiNbO_3 , etc. in Glan-Taylor and Glan-Laser polarizers as well as walk-off beam splitters, especially for high power and UV polarizers due to its unique UV transparency, good mechanical properties and high damage threshold.

Basic Properties

Chemical Formula	$\alpha\text{-BaB}_2\text{O}_4$
Transparency Range	189 - 3500 nm
Crystal Structure	Hexagonal system C_{3v}^6
Unit Cell Dimensions	$a = b = 0.7235\text{nm}$, $c = 3.9192\text{nm}$
Mohs hardness	4.5
Melting Point	1095°C
Density	3.85 g/cm ³
Optical Homogeneity	$\Delta n \approx 10^{-6}/\text{cm}$
Hygroscopic Susceptibility	>Low
Therm-Optic Coefficients	$dn_o/dT = -9.3 \times 10^{-6}/^\circ\text{C}$, $dn_e/dT = -16.6 \times 10^{-6}/^\circ\text{C}$
Thermal Expansion Coefficients (in the range of 25°C - 900°C)	$a_a = 4 \times 10^{-6}/\text{K}$ $a_c = 36 \times 10^{-6}/\text{K}$
Damage Threshold:	1GW/cm ² @ 1064 nm; 500 MW/cm ² @ 532 nm
Refractive Indices, Birefringence ($\Delta n = n_e - n_o$) and Walk-off Angle at 45° (ρ)	
$n_e = 1.58462$, $n_o = 1.65790$, $\Delta n = -0.073282$, $\rho = -4.9532^\circ$ at 1064 nm	
$n_e = 1.60206$, $n_o = 1.67755$, $\Delta n = -0.075491$, $\rho = -5.0407^\circ$ at 532 nm	
$n_e = 1.67190$, $n_o = 1.76171$, $\Delta n = -0.089805$, $\rho = -5.6926^\circ$ at 266 nm	

Standard Specifications

Beam Deviation	< 3 arc minutes
Optic Axis Orientation	$\pm 0.5^\circ$
Surface Quality	Scratch/Dig 20/10 to MIL-O-13830A
Flatness	$\lambda/4$ @ 633nm
Transmission Wavefront Distortion	< $\lambda/2$ @ 633 nm
AR Coating	R<0.5%

Applications of α -BBO

Please refer to Polarizer for the applications of α -BBO

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Calcite is a negative uniaxial crystal that has high birefringence, wide spectral transmission and availability in reasonably sized rhombs. Although is a fairly soft crystal and is easily scratched, it is ideal material used as visible and near IR polarizers, such as Glan Taylor, Glan Thompson and Glan laser.

AOTK selects carefully the raw calcite crystals by inspecting them with a cw green laser beam. We have perfected a number of proprietary processes for cutting, grinding and polishing good quality optical surfaces for calcite prism. These skills are evident in the high quality of the finished components, and enable polarizers to be used with very high peak power lasers.

Basic Properties

Density	2.7g/cm ³
Transparency Range	350 - 2300 nm
Particle Shape	Crystalline Rhombic
Mohs Hardness	3
Hygroscopic Susceptibility	Low susceptibility to moisture
Thermal Expansion Coefficients	$\alpha_a = 24.39 \times 10^{-6}/K$; $\alpha_c = 5.68 \times 10^{-6}/K$
Crystal Class	Negative uniaxial with $n_o=n_a=n_b$, $n_e=n_c$
Refractive Indices, Birefringence ($\Delta n = n_e - n_o$) and Walk-off Angle at 45° (ρ)	
$n_e = 1.4852$, $n_o = 1.6557$, $\Delta n = -0.1705$, $\rho = 6.20^\circ @ 630nm$	
$n_e = 1.4885$, $n_o = 1.6629$, $\Delta n = -0.1744$, $\rho = 6.32^\circ @ 1300nm$	
Sellmeyer Equation (λ in μm)	
$n_o^2 = 2.69705 + 0.0192064/(\lambda^2 - 0.01820) - 0.0151624\lambda^2$	
$n_e^2 = 2.18438 + 0.0087309/(\lambda^2 - 0.01018) - 0.0024411\lambda^2$	

Standard Fabrication Specifications

Beam Deviation	< 3 arc min.
Optic Axis Orientation	$\pm 0.5^\circ$
Dimension Tolerance	$\pm 0.1mm$
Surface quality	Scratch/Dig 20/10 to MIL-O-13830A
Flatness	< $\lambda/4 @ 633nm$
Transmission Wavefront Distortion	< $\lambda/2 @ 633 nm$
AR Coating	R < 0.5%

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