

Yttrium Vanadate (YVO₄) Crystal

Introduction

The Yttrium Orthovanadate (YVO₄) is a positive uniaxial crystal grown with Czochralski method. It has good temperature stability and physical and mechanical properties. It is ideal for optical polarizing components because of its wide transparency range and large birefringence. It is an excellent synthetic substitute for Calcite (CaCO₃) and Rutile (TiO₂) crystals in many applications including fiber optic isolators and circulators, interleavers, beam displacers and other polarizing optics (refer to Table 1).

Table 1. Comparison of basic properties between YVO₄ and other Birefringent Crystals

		YVO ₄	TiO ₂	CaCO ₃	LiNbO ₃
Thermal Expansion (/°C)	c-axis	11.4x10 ⁻⁶	9.2x10 ⁻⁶	26.3x10 ⁻⁶	16.7x10 ⁻⁶
	a-axis	4.4x10 ⁻⁶	7.1x10 ⁻⁶	5.4x10 ⁻⁶	7x10 ⁻⁶
Refractive Index	n _o	1.9447@1550nm	2.454@1530nm	1.6346@ 1497nm	2.2151@ 1440nm
	n _e	2.1486@1550nm	2.710@1530nm	1.4774@ 1497nm	2.1413@ 1440nm
Birefringence (n _e -n _o)		0.2039@1550nm	0.256@1530nm	-0.1572@ 1497nm	-0.0738@ 1440nm
Mohs Hardness		5	6.5	3	5
Deliquescence		None	None	Weak	None
Transparency range		0.4-5μm	0.4-5μm	0.35-2.3μm	0.4-5μm

A reliable supplier of YVO₄ crystals

CASTECH is one of the earliest companies who have mastered the advanced growth technique of YVO₄ crystal. Now CASTECH has completed its strong mass-production line that can provide:

- Various size of bulk and finished high quality YVO₄ crystals up to φ35x50mm³ and φ20x20mm³, respectively;
- Large quantity YVO₄ wedges and displacers used for fiber optical isolators and circulators, interleavers, in size of 1.25x1.25x0.5mm³ to 3x3x15mm³ to meet OEM customer's requirement;
- Quick delivery;
- Very competitive price;
- Strict quality control;
- Technical support;

Basic Properties of YVO₄ crystal

Transparency Range:	High transmittance from 0.4 to 5μm
Crystal Symmetry:	Zircon Tetragonal, space group D _{4h}
Crystal Cell:	a=b=7.12Å; c=6.29Å
Density:	4.22 g/cm ³

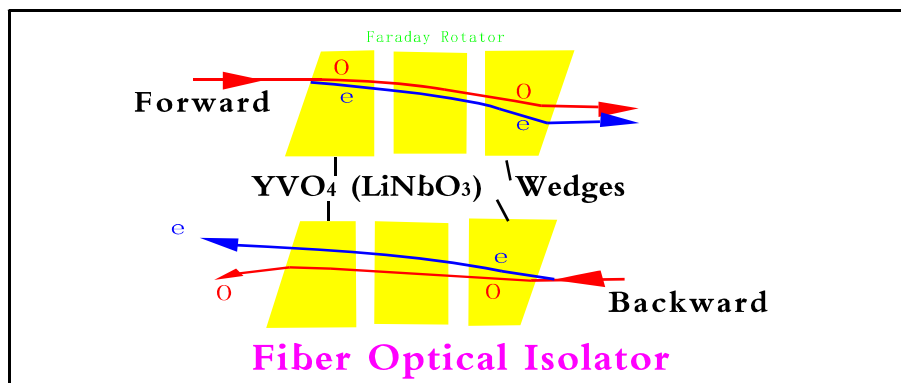
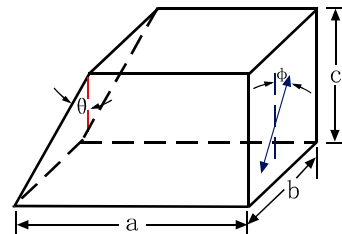
Mohs Hardness:	5, glass-like
Hygroscopic Susceptibility:	Non-hygroscopic
Thermal Expansion Coefficient:	$\alpha_a = 4.43 \times 10^{-6}/K$; $\alpha_c = 11.37 \times 10^{-6}/K$
Thermal Conductivity Coefficient :	//C: 5.23 W/m/K; \perp C: 5.10 W/m/K
Crystal Class:	Positive uniaxial with $n_o = n_a = n_b$, $n_e = n_c$
Thermal Optical Coefficient:	$dn_a/dT = 8.5 \times 10^{-6}/K$; $dn_c/dT = 3.0 \times 10^{-6}/K$
Refractive Indices, Birefringence ($\Delta n = n_e - n_o$) and Walk-off Angle at 45° (ρ):	$n_o = 1.9929$, $n_e = 2.2154$, $\Delta n = 0.2225$, $\rho = 6.04^\circ$ at 630nm $n_o = 1.9500$, $n_e = 2.1554$, $\Delta n = 0.2054$, $\rho = 5.72^\circ$ at 1300nm $n_o = 1.9447$, $n_e = 2.1486$, $\Delta n = 0.2039$, $\rho = 5.69^\circ$ at 1550nm
Sellmeier Equation (λ in μm):	$n_o^2 = 3.77834 + 0.069736/(\lambda^2 - 0.04724) - 0.0108133 \lambda^2$ $n_e^2 = 4.59905 + 0.110534/(\lambda^2 - 0.04813) - 0.0122676 \lambda^2$

YVO₄ crystal application

YVO₄ crystals are widely used in fiber-optic isolators, beam displacers and optical circulators, etc.

1. Specifications of birefringent wedges for fiber-optic isolators

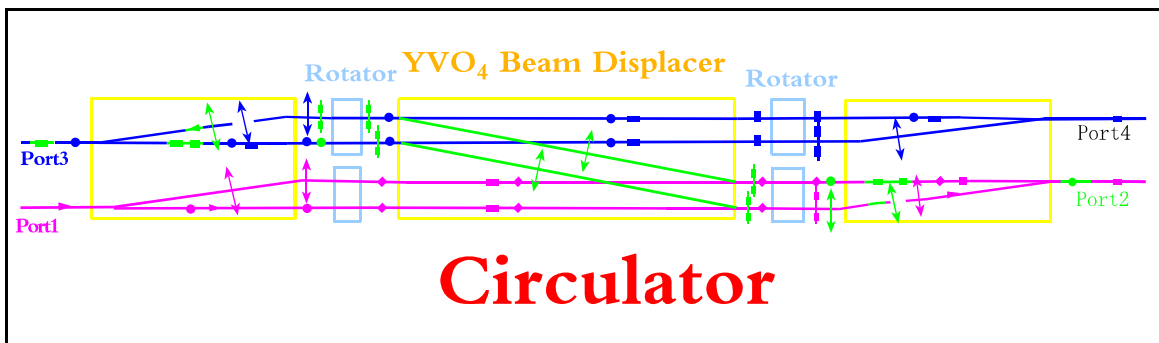
Aperture	1.0 x 1.0 mm ² to 4 x 4 mm ²
Dimension tolerance	+/-0.05mm
Wedge Angle tolerance	+/-0.1°
Optical axis orientation	+/-0.5°
Flatness	$\lambda/4$ @ 632.8 nm
Surface Quality	20-10
AR-coating	R<0.2% @1550 or 1310nm
Standard Size	1.25mmx1.25mmx0.5mm with 13° or 15° wedge, $\phi=22.5^\circ$



Specifications of YVO₄ beam displacers for fiber-optic circulators or interleaver

Dimension tolerance	W ($\pm 0.05\text{mm}$) \times H ($\pm 0.05\text{mm}$) \times L ($\pm 0.1\text{mm}$)
Optical axis orientation	$\pm 0.5^\circ$
Parallelism	< 15 arc sec
Perpendicularity	< 10 arc min
Flatness	$\lambda/4$ @ 632.8 nm
Surface Quality	20/10
AR-coating	R $< 0.2\%$ @ 1550 nm or 1310nm ± 40 nm
Standard Size	2.6 \times 2.6 \times 10mm, $\theta=45^\circ$, $\phi=0^\circ$

Note: Other sizes and specifications are available upon request



YVO₄ Beam Displacer for Circulator

