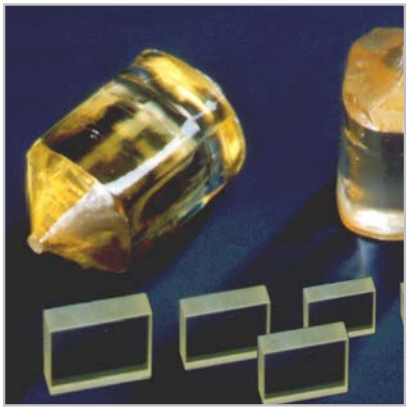
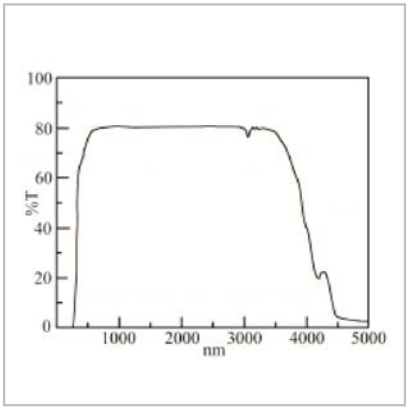
Yttrium Vanadate (YVO_4) Crystal

The yttrium orthovanadate (YVO_4) is a positive uniaxial crystal grown 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 (TiO_2) crystals in many applications including fiber optic isolators and circulators, beam displacers, Glan polarizers and other polarizing optics, etc.



Basic Properties of YVO_4 Crystals

Transparency range	high transmittance from 0.4 to 5 µm
Crystal symmetry	zircon tetragonal, space group D_{4h}
Crystal cell	a = b = 7.12 Å; c = 6.29 Å
Density	4.22 g/cm³
Hygroscopic susceptibility	non-hygroscopic
Mohs hardness	5, glass-like
Thermal expansion coefficient	α_a = 4.43 x 10^{-6}/K; α_c = 11.37 x 10^{-6}/K
Thermal conductivity coefficient	∥C: 5.23 W/m/K; ⊥C: 5.10 W/m/K
Crystal class	positive uniaxial with $n_o = n_a = n_b$, $n_e = n_c$



Transparency Curve of YVO_4 (Thickness = 1mm)

United Kingdom
Laser Components (UK) Ltd.
Tel: +44 1245 491 499
Fax: +44 1245 491 801
info@lasercomponents.co.uk
www.lasercomponents.co.uk

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Refractive indices, birefringence ($\Delta n = n_e - n_o$) and walk-off angle at 45° (ρ):

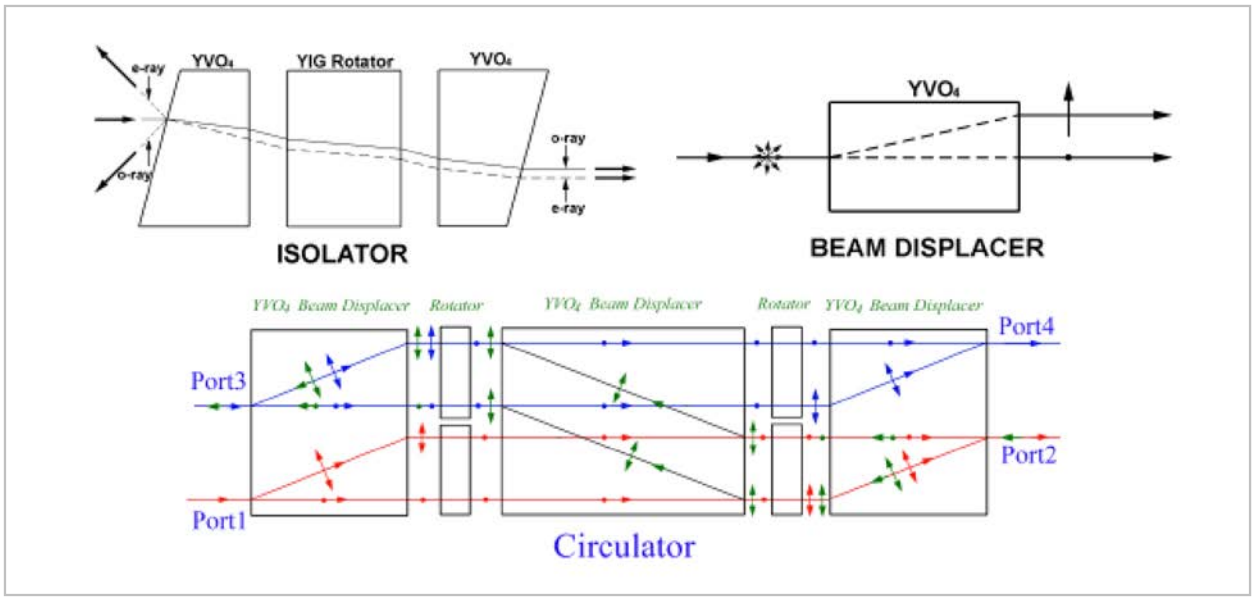
n_o = 1.9929, n_o = 1.9500, n_o = 1.9447,	n_e = 2.2154, n_e = 2.1554, n_e = 2.1486,	Δn = 0.2225, Δn = 0.2054, Δn = 0.2039,	ρ = 6.04° ρ = 5.72° ρ = 5.69°	at 0.63 µm at 1.30 µm at 1.55 µm
Sellmeier equation (λ in µm):	$n_o^2 = 3.77834 + 0.069736/(\lambda^2 - 0.04724) - 0.0108133\lambda^2$ $n_e^2 = 4.59905 + 0.110534/(\lambda^2 - 0.04813) - 0.0122676\lambda^2$			
Thermal optical coefficient	$dn_a/dT = 8.5 \times 10^{-6}/K$; $dn_c/dT = 3.0 \times 10^{-6}/K$			

Comparation With Other Birefringent Crystals

- Compared to Calcite, YVO_4 has better temperature stability and physical and mechanical properties. Calite is hard to obtain high optical quality because of its low susceptibility to moisture and low hardness.
- Compared to Rutile (TiO_2) which exhibits too high hardness, YVO_4 is easier to be handled for optical surface processing that greatly reduces cost of fabrication, especially for batch production.
- Compared to $NiNbO_3$, although they have similar mechanical and physical properties, YVO_4 has more than three times larger birefringence, that makes your design more compact.

Applications of YVO_4 Crystals

Following drawings are the simple demonstrations of how the YVO_4 crystals are used in fiber optic isolator, beam displacers and circulators.



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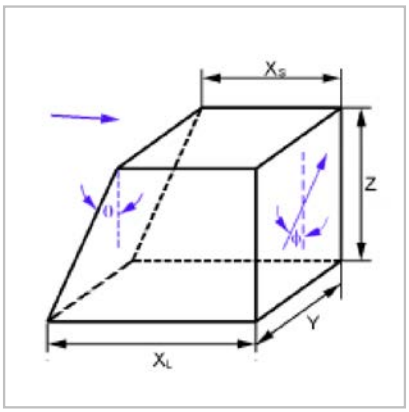
Birefringent Wedges for Fiber-Optic Isolators

Specifications

Aperture	1.0 x 1.0 mm^2 to 2 x 2 mm^2
Dimension tolerance	+/−0.05 mm
Wedge angle tolerance	+/−15%
Optical axis orientation	+/− 0.5°
Flatness	λ/4 @ 632.8 nm
Surface quality	20−10
AR-coating	R<0.2% @ 1550 nm

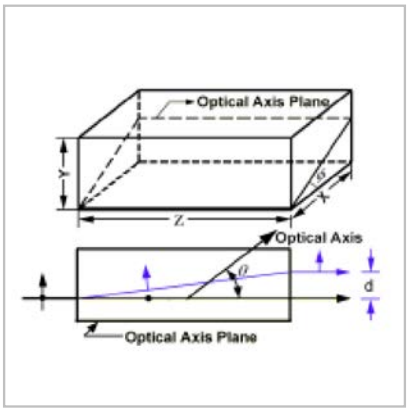


Note: Other sizes and coating are available upon request.

YVO_4 Beam Displacer

Specifications

Dimension tolerance	±0.05 x ±0.05 x ±0.1mm
Optical axis orientation	+/−0.5°
Parallelism	<15 arc sec
Perpendicularity	<10 arc min
Flatness	λ/4 @ 632.8 nm
Surface quality	20−10
AR-coating	R<0.2% @ 1550 nm ±40 nm



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Standard Size

P/N	Crystal	Size	θ	ϕ	d	AR@
PBD3070	YVO_4	2.6 x 2.6 x 7 mm	45°	0°	0.70 mm	1550 nm
PBD3100	YVO_4	2.6 x 2.6 x 10 mm	45°	0°	1.00 mm	1550 nm
PBD3120	YVO_4	2.6 x 2.6 x 12 mm	45°	0°	1.20 mm	1550 nm
PBD3150	YVO_4	2.6 x 2.6 x 15 mm	45°	0°	1.50 mm	1550 nm
PBD3075	YVO_4	2.6 x 2.6 x 7 mm	45°	45°	0.70 mm	1550 nm
PBD3105	YVO_4	2.6 x 2.6 x 10 mm	45°	45°	1.00 mm	1550 nm
PBD3125	YVO_4	2.6 x 2.6 x 12 mm	45°	45°	1.20 mm	1550 nm
PBD3155	YVO_4	2.6 x 2.6 x 15 mm	45°	45°	1.50 mm	1550 nm

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