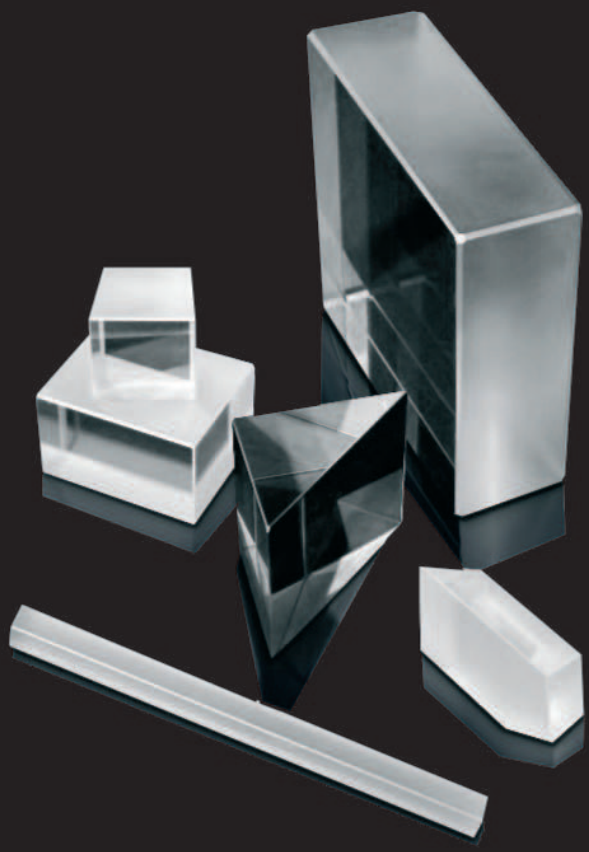
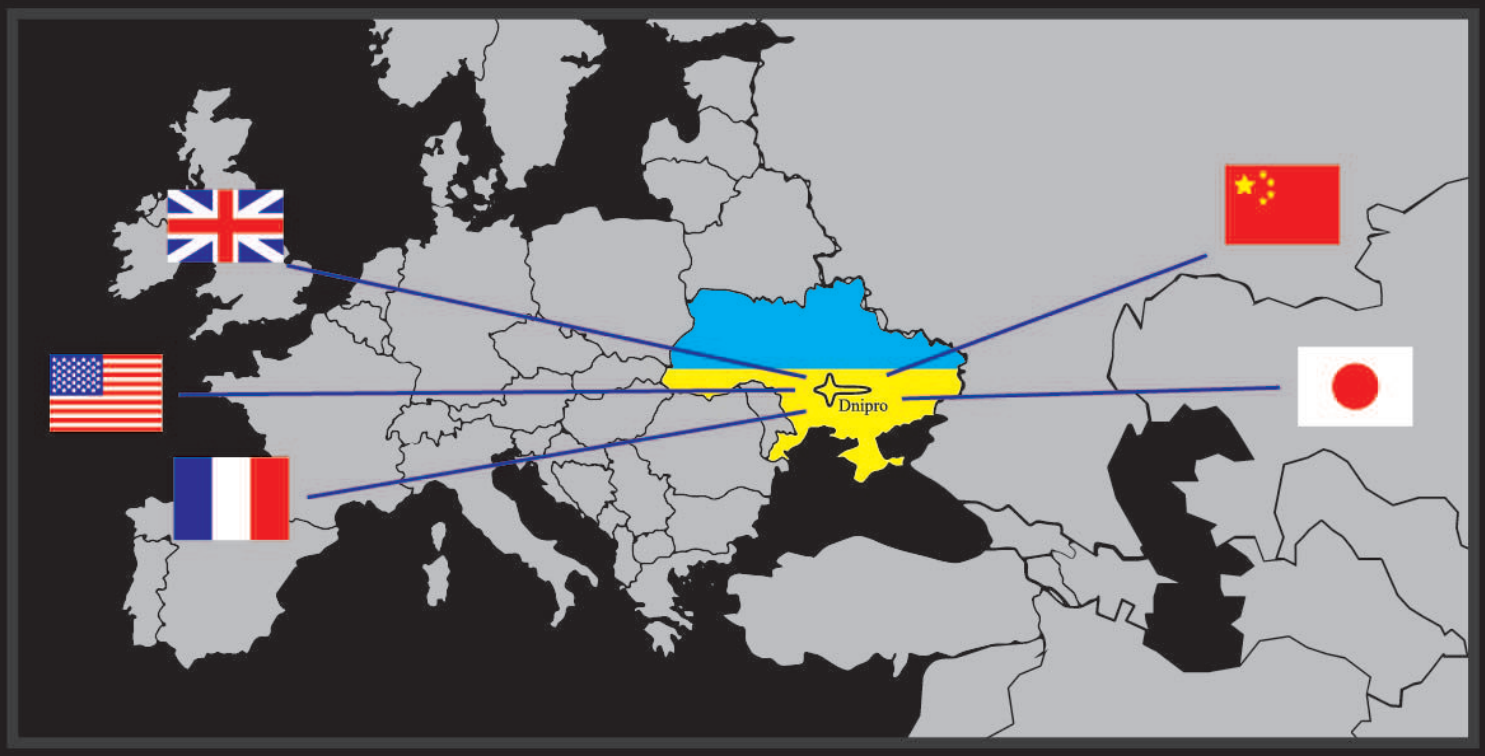


# Elent A
# Elent Technics

successful Ukrainian manufacturer of TeO2 single crystals since 1992.

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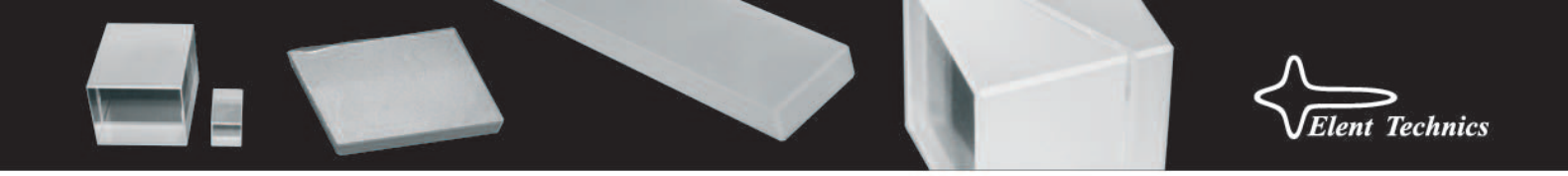
www.elent-a.net; elentcrystals@gmail.com

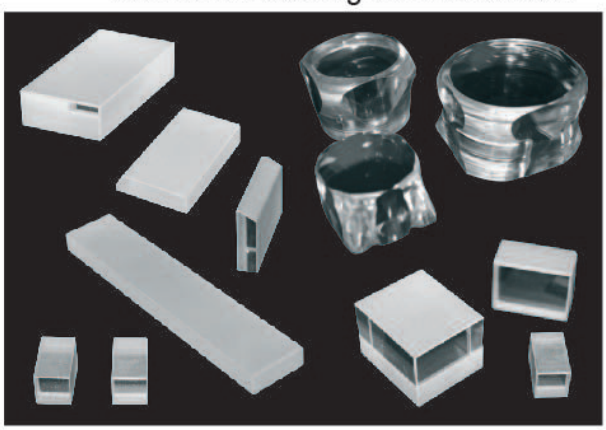
info@elent-a.net




# $TeO_2$ - The best Acousto-Optical birefringent crystal

**Application - AO modulators (telecommunication), AO deflectors (2D scanning), AO Tunable Filters (spectral analysis), polarizing optics**

- Czochralski growth method
- High laser quality and uniformity of all crystal volume
- No bubbles, inclusions, striaes and mechanical stresses
- Minimum scattering on microdefects



| Specification | |
|---|---|
| Material | $TeO_2$ - Colorless synhetic single crystal |
| Symmetry | Tetrogonal, 422 (D4) |
| Lattice distances | a = 4.8122 Å ; c = 7.6157 Å |
| Molecular weight | 159.5 |
| Density, g/cm³ | 5.99 ± 0.03 |
| Melting point | 733 °C |
| Transmission: | 0.35 - 5.0 μm |
| Power capability | 200 MWt/cm² or 2 x $10^8$ W/cm2 (1064 nm,12 ns, 1Hz) |

## We offer several material types for various application:

- Standard material is better for the range 0,450-2,5 mkm;
- $TeO_2$ crystal grown under special technology maximizing transmittans in the range 0,350 - 0,450 mkm - for application sensitive to the solarization effect;
- $TeO_2$ crystal grown under special technology minimizing absorption on - OH group in the range 2,7 - 3,2 mkm - for application demanded plane transmission range.

## Capabilities

**Raw material:** cleaned according to our own technology up to 6N

**Crystal growth:** boule Diam. up to 90-100mm Height 50mm (axial (100))

**Cut:** diamond band saw with cutting width 0,5mm and less

**X-Ray orientation:** accuracy surfaces ±1' and angles ±2'

**Grinding:** tolerance 10mkm and less, repeatability - 5mkm

**Polishing:** S/D-10/5, flatness λ/10(633 nm), parallelism 10-15'', angle tollerance between polished surfaces up to 3''

**Coating:** AR,R<0,25% for one wavelengths, R<1% for wide range & Protective coating

## Typical sizes (blanks stock items)

| Item ID# | Sizes, mm along axis | X-ray accuracy | Size Tolerance | Surface [110] | Surface [1-10] | Surface [001] |
|---|---|---|---|---|---|---|
| BC-01-CP1 | 10(110)x25(1-10)x6(001) | <5' | ±0,25 mm | S/D-80/60, λ | ground 15 μm grit | ground 15 μm grit |
| BC-02-CP1 | 20(110)x32(1-10)x10(001) | <5' | ±0,25 mm | S/D-80/60, λ | ground 15 μm grit | ground 15 μm grit |
| BC-03-CP1 | 13(110)x33(1-10)x13(001) | <5' | ±0,25 mm | ground 15 μm grit | ground 15 μm grit | S/D-80/60, λ |
| BC-04-CP2 | 25(110)x30(1-10)x25(001) | <5' | ±0,25 mm | S/D-80/60, λ | ground 15 μm grit | S/D-80/60, λ |
| BC-05-CP1 | 15(110)x45(1-10)x55(001) | <5' | ±0,25 mm | ground 15 μm grit | ground 15 μm grit | S/D-80/60, λ |
| BC-06-FP2 | 20(110)x35(1-10)x8(001) | <2' | ±0,10 mm | S/D-10/5, λ/4 | ground 15 μm grit | S/D-20/10, λ/4 |
| BC-07-FP2 | 19(110)x38(1-10)x13(001) | <2' | ±0,10 mm | S/D-20/10, λ/2 | ground 15 μm grit | ground 15 μm grit |
| BC-08-Gr | 2(110)x25(1-10)x25(001) | <10' | ±0,5 mm | ground 15 μm grit | ground 15 μm grit | ground 15 μm grit |

## Note

- Other crystal sizes, orientation, polishing can be also supplied according to your specific requirements.

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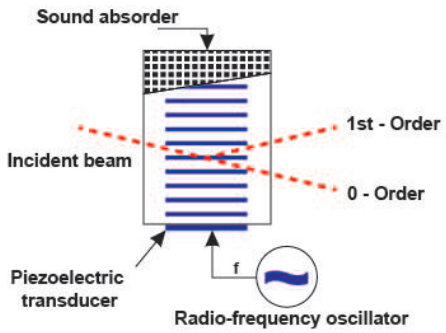
# $TeO_2$ - The best Acousto-Optical birefringent crystal

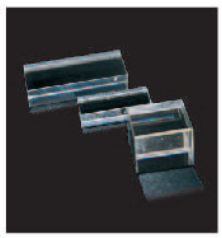
**Some typical application**

## Acousto-optical modulators (AOM)

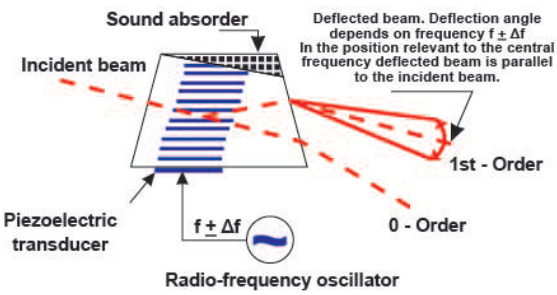



| AOM main characteristics | Typical values |
|---|---|
| Optical Wavelength Range | 514nm, 633nm, 1064nm, 1330nm |
| Optical Aperture | 0.3 mm - 3 mm |
| Operating Mode | Longitudinal, axis (001) |
| Optical Rise Time | 9-200 nsec on beam diameter |
| Beam Separation (633 nm) | 10-30 mrad |
| Diffraction Efficiency | 70-85 % |
| RF Drive Power | 500-1000 mwatts |
| Modulation Frequency (-3db) | 6-50 MHz |

AOM blanks with different interaction length

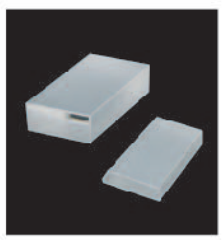


## Acousto-optical Deflectors/Scanners (AOD) anisotropic diffraction

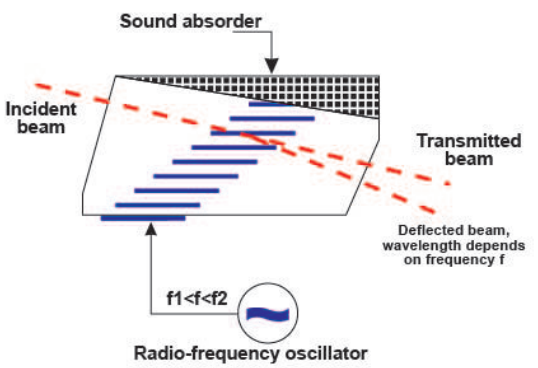



| AOD main characteristics | Typical values |
|---|---|
| Optical Wavelength Range | 514nm, 633nm, 1064nm, 1330nm |
| Optical Aperture | 1 mm - 20 mm |
| Operating Mode | Slow shear, off axis |
| Beam Separation (80 MHz) | 60-80 mrad |
| Deflection Angle | 30-60 mrad |
| Diffraction Efficiency | 70-85 % |
| RF Drive Power | 1-5 watts |
| Access Time | 1.5 μs/mm beam widht |

AOD blanks
13x14x20 mm
9x10x17 mm

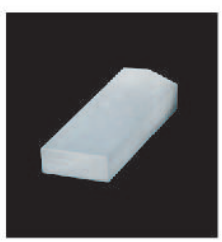


## Acousto-optical Tunable Filters. Noncollinear propagation (AOTF)



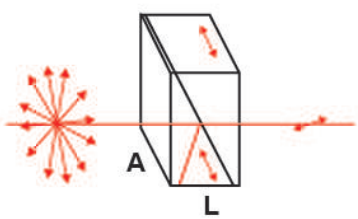

| AOTF main characteristics | Typical values |
|---|---|
| Optical Wavelength Range | 355nm - 5000 nm |
| Optical Aperture | 1 mm - 20 mm |
| Operating Mode | Slow shear, off axis |
| Transmission Bandwidth FWHM | 3-15 nm |
| Frequency Range: | 17-200 MHz |
| Diffraction Efficiency | 90-95 % |
| Field of View | ±1-3° |
| Pointing stability of diffracted order | ± 0.01° typical |

AOTF blanks
8x25x42 mm

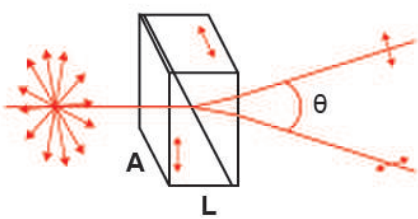


## Polarizing Optics

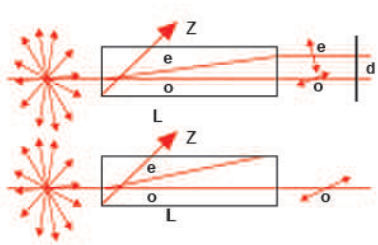
### Glan Polarizing Prism




### Wollaston Polarizing Prism




### Beam Displacers




## Note

- For polarizing optic details please see correspndent pages with prism types and beam displacer information.

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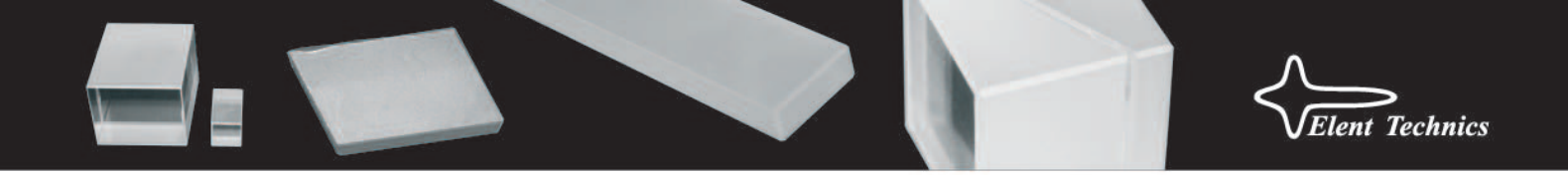
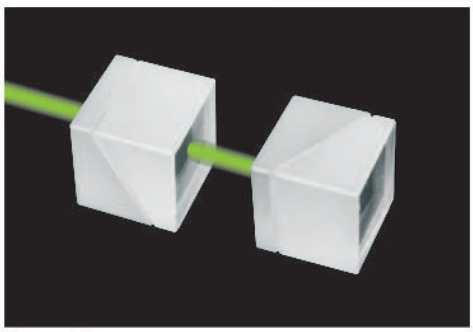



# $TeO_2$ - Glan Polarizing Prism (glued) | GPGL

**The most popular prism for linear polarizing light**
**Application - scienfic & industrial fields where polarizing light is used**

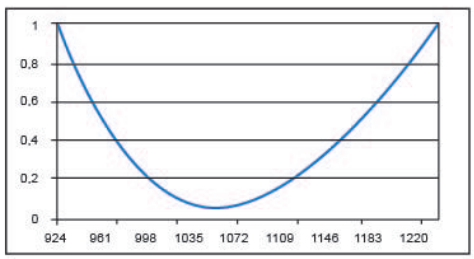
- Two prisms are connected with a glue with a specially selected refractive index
- Working is ordinary beam extraordinary beam is absorbed by side surface
- Angular aperture two times larger the prism air-clearance



| Specification | |
|---|---|
| Material | $TeO_2$ |
| Extinction ratio | <1:100000 |
| Power capability | 200 MWt/cm² or 2 x $10^8$ W/cm² (1064 nm, 12 ns, 1 Hz) |
| Surfaces quality (S/D) | 20/10 |
| Flatness | 1/4 lambda (633 nm) |

## Coatings

Standard prisms are supplied without coating.
According to your request we can put AR coating on in and out prism faces for selected wavelength with R<0,4%.
Also we offer multilayer broadband AR or Protective coatings to in and out prism faces.
For detalied information please see part **Coating**.



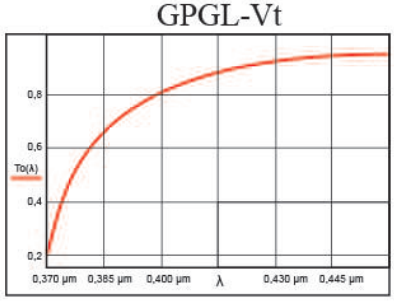

## We offer four prism types:

Type **GPGL-Vt** - 370 - 460 nm basic wavelength is 405 nmα = 8,00° (for this wavelength α max and symmetrical)
Type **GPGL-Vis** - 430 - 700 nm basic wavelength is 514 nmα = 7,69° (for this wavelength α max and symmetrical)
Type **GPGL-NIR** - 600 - 1800 nm basic wavelength is 800 nmα = 7,47° (for this wavelength α max and symmetrical)
Type **GPGL-MIR** - 1000 - 5000 nm basic wavelength is 1330 nmα = 7,40° (for this wavelength α max and symmetrical)

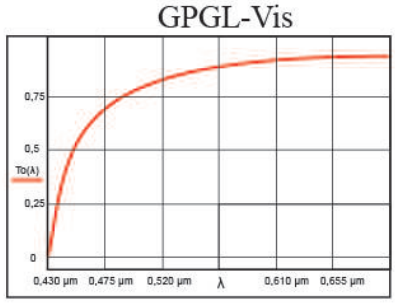
| | Recommended optical window mm | Size, A, mm | Length, L, mm |
|---|---|---|---|
| GPGL-Vt-10-13 | 10 | 10 | 13 |
| GPGL-Vt-12-15 | 12 | 12 | 15 |
| GPGL-Vt-16-19 | 16 | 16 | 19 |
| GPGL-Vt-20-23 | 20 | 20 | 23 |
| GPGL-Vt-25-27 | 25 | 25 | 27 |
| GPGL-Vt-30-31 | 30 | 30 | 31 |
| GPGL-Vt-35-35 | 35 | 35 | 35 |
| GPGL-Vt-40-40 | 40 | 40 | 40 |
| GPGL-Vis-10-13 | 10 | 10 | 13 |
| GPGL-Vis-12-15 | 12 | 12 | 15 |
| GPGL-Vis-16-19 | 16 | 16 | 19 |
| GPGL-Vis-20-23 | 20 | 20 | 23 |
| GPGL-Vis-25-27 | 25 | 25 | 27 |
| GPGL-Vis-30-31 | 30 | 30 | 31 |
| GPGL-Vis-35-35 | 35 | 35 | 35 |
| GPGL-Vis-40-40 | 40 | 40 | 40 |

Transmission coefficient of ordinary **To** ray

GPGL-Vt

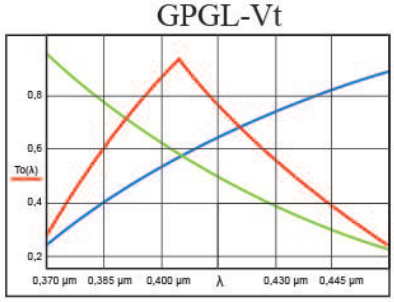



GPGL-Vis

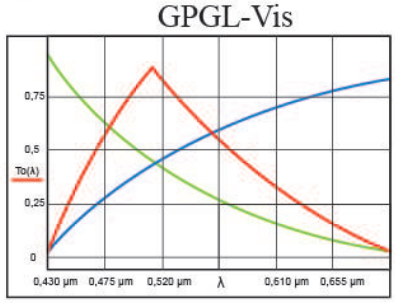



Angle Aperture

GPGL-Vt




GPGL-Vis




## Note

- Full angular aperture is equal to the doubled value of minimum aperture;
- Other types of GPGL-NIR and GPGL-MIR are also available;
- Upon your request we can supply prisms with any selected base wavelength and with aperture up to 50mm;
- Mounted prisms are also available upon request.

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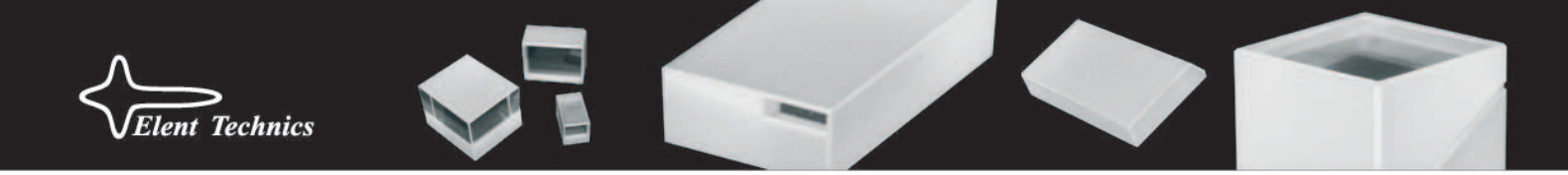
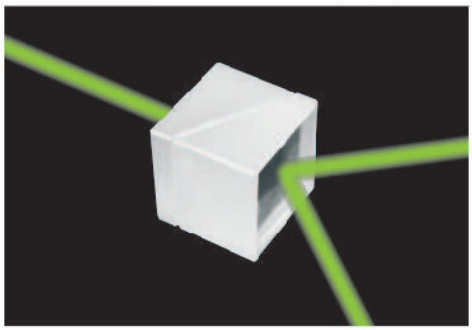


# $TeO_2$ - Wollaston Polarizing Prism | WPP

**Prism separates the incident beam into two linearly polarized beams with orthogonal polarizing orientation**
**Application - phase-contrast microscopes, interferometers etc.**

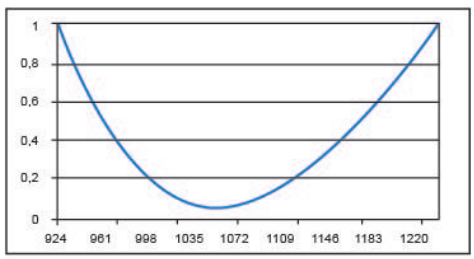
- Two prisms where optic axes are mutually perpendicular are cemented together
- Light propagation direction doesn't coincide with optic axis in no one prism half that completely excludes parasitic effect of crystals optical activity



| Specification | |
|---|---|
| Material | $TeO_2$ |
| Extinction ratio | <1:100000 |
| Power capability | 200 MWt/cm² or 2 x $10^8$ W/cm² (1064 nm, 12 ns, 1 Hz) |
| Surfaces quality (S/D) | 20/10 |
| Flatness | 1/4 lambda (633 nm) |

## Coatings

Standard prisms are supplied without coating.
According to your request we can put AR coating on in and out prism faces for selected wavelength with R<0,4%.
Also we offer multilayer broadband AR or Protective coatings to in and out prism faces.
For detalied information please see part **Coating**.



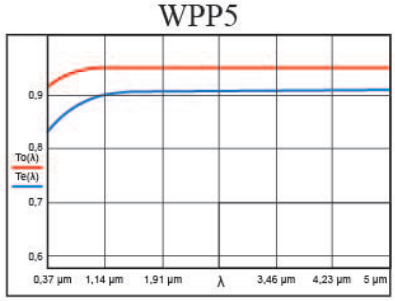

## We offer two prism types:

Type **WPP5** - beam displace θ=5 degrees for 633 nm with ration of lenght to the aperture L/A=0,5-1
Type **WPP10** - beam displace θ=10 degrees for 633 nm with ration of lenght to the aperture L/A=0,8-1,2

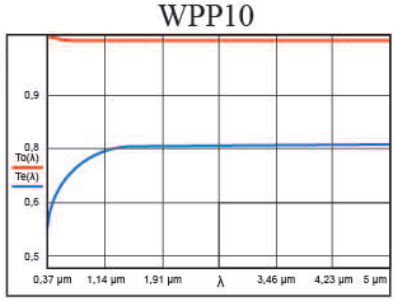
| | Recommended optical window mm | Size, A, mm | Length, L, mm |
|---|---|---|---|
| WPP5-10-10 | 10 | 10 | 13 |
| WPP5-12-11 | 12 | 12 | 11 |
| WPP5-16-12 | 16 | 16 | 12 |
| WPP5-20-13 | 20 | 20 | 13 |
| WPP5-25-14 | 25 | 25 | 14 |
| WPP5-30-16 | 30 | 30 | 16 |
| WPP5-35-18 | 35 | 35 | 18 |
| WPP5-40-20 | 40 | 40 | 20 |
| WPP10-10-12 | 10 | 10 | 12 |
| WPP10-12-14 | 12 | 12 | 14 |
| WPP10-16-17 | 16 | 16 | 17 |
| WPP10-20-19 | 20 | 20 | 19 |
| WPP10-25-22 | 25 | 25 | 22 |
| WPP10-30-25 | 30 | 30 | 25 |
| WPP10-35-28 | 35 | 35 | 28 |
| WPP10-40-32 | 40 | 40 | 32 |

Transmission coefficient of ordinary **To** and extraordinary **Te** rays

WPP5

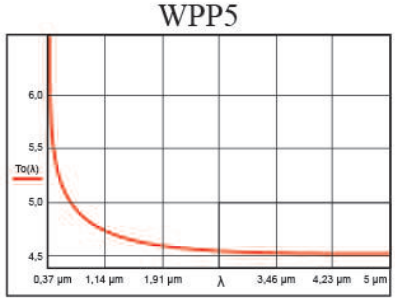



WPP10

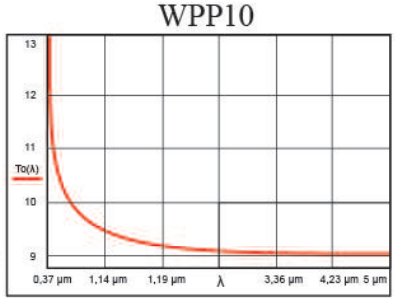



Beam displacing angle θ

WPP5




WPP10




## Note

- Separation angle and transmission will vary depending on the wavelength, please see upper schedules;
- Upon your request we can supply prisms with aperture up to 50 mm;
- Mounted prisms are also available upon request.

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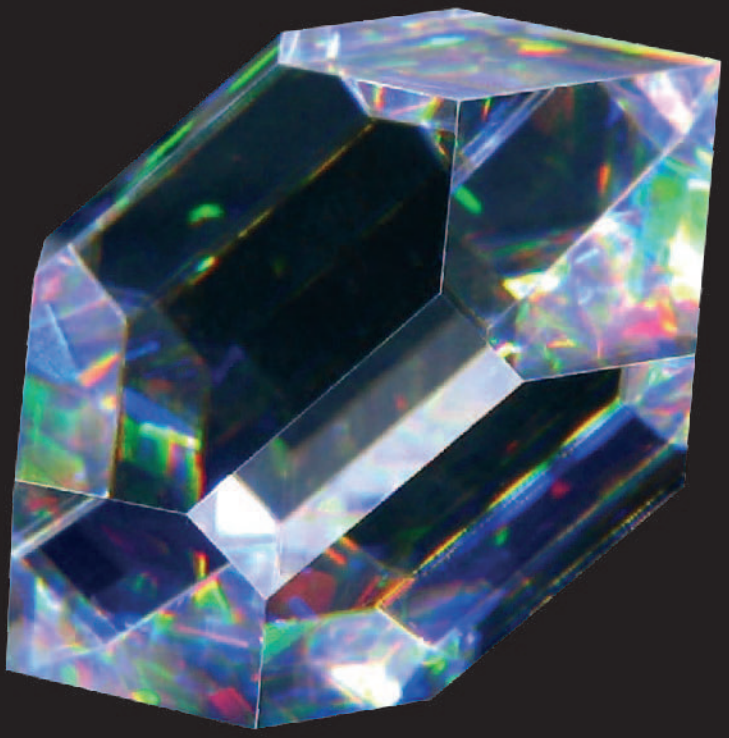

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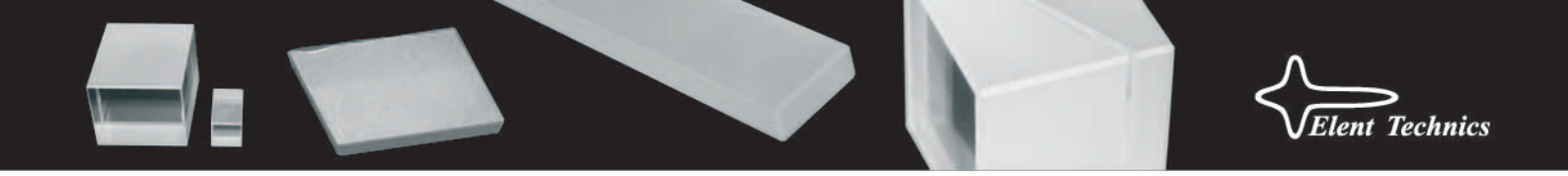
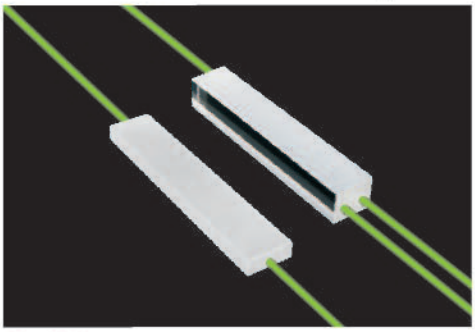


# $TeO_2$ - Beam Displacer & Beam Polarizer | BD & BP

**BD separates the incident beam into two linearly polarized beams with orthogonal polarizing orientation**
**BP gives linear polarizing light**
**Application - microscopes, interferometers etc.**

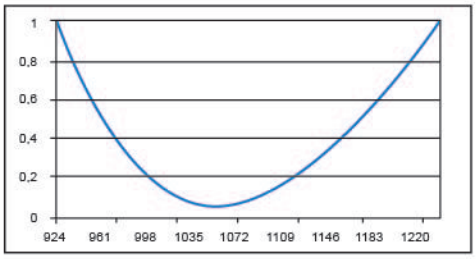
- One piece crystal with a special orientation of the optical axis
- Outer beams are parallel to each other at a specified distance
- Ordinary ray propagates without changes, extraordinary - deflects inside the the crystal
- In BP - extraordinary ray is absorbed by the side surface
- Minimum absorption over the whole range of use
- Wide range of uses from 0.35 to 5 μm



| Specification | |
|---|---|
| Material | $TeO_2$ |
| Extinction ratio | <1:100000 |
| Power capability | 200 MWt/cm² or 2 x $10^8$ W/cm² (1064 nm, 12 ns, 1 Hz) |
| Surfaces quality (S/D) | 20/10 |
| Flatness | 1/4 lambda (633 nm) |

## Coatings

Standard prisms are supplied without coating.
According to your request we can put AR coating on in and out prism faces for selected wavelength with R<0,4%.
Also we offer multilayer broadband AR or Protective coatings to in and out prism faces.
For detalied information please see part **Coating**.

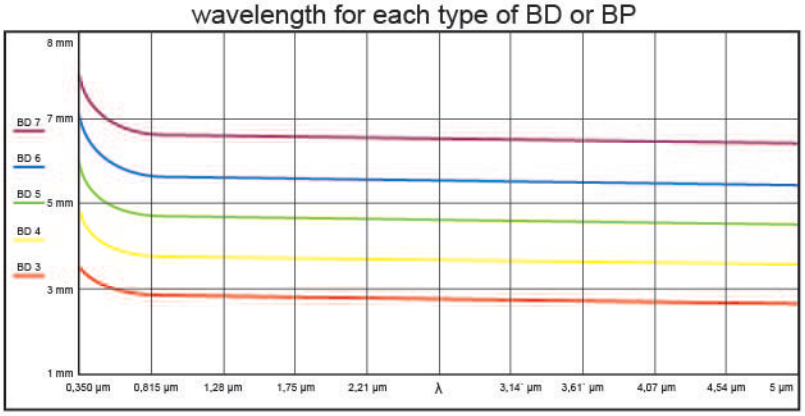



## We offer five types of BD & BP:

Type **BP3** - separation distance of the output beam is 3 mm for a wavelength of 633 mm
Type **BP4** - separation distance of the output beam is 4 mm for a wavelength of 633 mm
Type **BP5** - separation distance of the output beam is 5 mm for a wavelength of 633 mm
Type **BP6** - separation distance of the output beam is 6 mm for a wavelength of 633 mm
Type **BP7** - separation distance of the output beam is 7 mm for a wavelength of 633 mm
Type **BD3** - separation distance of the output beam is 3 mm for a wavelength of 633 mm
Type **BD4** - separation distance of the output beam is 4 mm for a wavelength of 633 mm
Type **BD5** - separation distance of the output beam is 5 mm for a wavelength of 633 mm
Type **BD6** - separation distance of the output beam is 6 mm for a wavelength of 633 mm
Type **BD7** - separation distance of the output beam is 7 mm for a wavelength of 633 mm

| | Apertura, AxB, mm | Length, L, mm |
|---|---|---|
| BP3-3-46 | 3x3 | 46 |
| BP4-4-61.5 | 4x4 | 61.5 |
| BP5-5-76.5 | 5x5 | 76.5 |
| BP6-6-92 | 6x6 | 92 |
| BP7-7-107 | 7x7 | 107 |
| BD3-7-46 | 3x7 | 46 |
| BD4-9-61.5 | 4x9 | 61.5 |
| BD5-11-76.5 | 5x11 | 76.5 |
| BD6-13-92 | 6x13 | 92 |
| BD7-15-107 | 7x15 | 107 |

Dependence of the distance separating output beam on wavelength for each type of BD or BP




## Note

- Upon your request we can supply BD & BP with aperture and beam separation distance;
- Mounted BD & BP are also available upon request.

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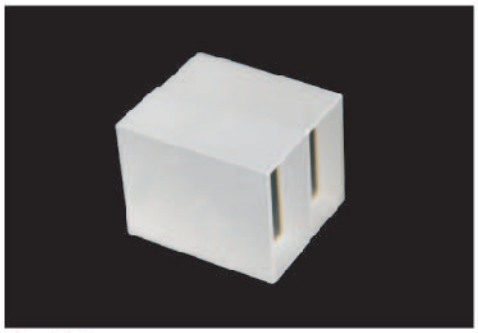
Elent Technics

# $TeO_2$ - Conoscopic Plates | CP

**CP separates the incident beam into two lineary polarized beams with orthogonal polarizing orientation**
**Application - conoscopic holography, 3-D scanning system, Savart interferometers etc.**

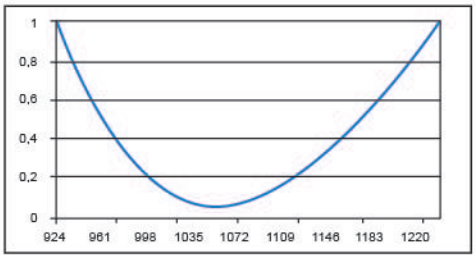
- High birefringence index
- Wide range of uses from 0.35 to 5 μm
- Outer beams are parallel to each other at a specified distance
- Minimum absorption over the whole range of use
- Aperture diameter up to 40 mm



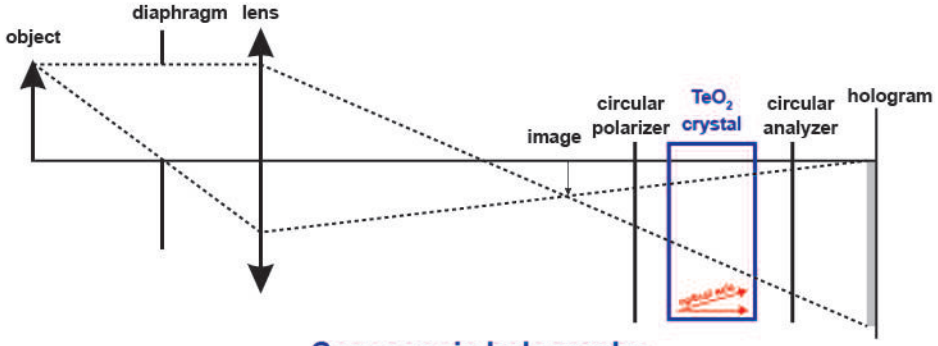
| Specification | |
|---|---|
| Material | Uniaxial $TeO_2$ crystal |
| Birefringence index | $\Delta n=n_e-n_o=2.412-2.26=0.153$ @633nm |
| Extinction ratio | <1:100000 |
| Surfaces quality (S/D) | 20/10 |
| Flatness | $^1/_4$ lambda (633 nm) |

## Coatings

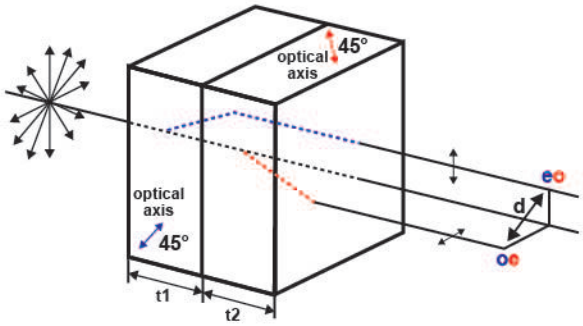
Standard prisms are supplied without coating.
According to your request we can put AR coating on in and out prism faces for selected wavelength with R<0,4%.
Also we offer multilayer broadband AR or Protective coatings to in and out prism faces.
For detalied information please see part **Coating**.




**We'd like to offer our industrial and scientific and customers to use $TeO_2$ plates as a new material in typical schemes for conoscopic holography and Savart interferometry.**




Conoscopic holography




Savart system

## Note

- Upon your request we can supply CP with aperture and beam separation distance;
- Mounted BP are also available upon request.

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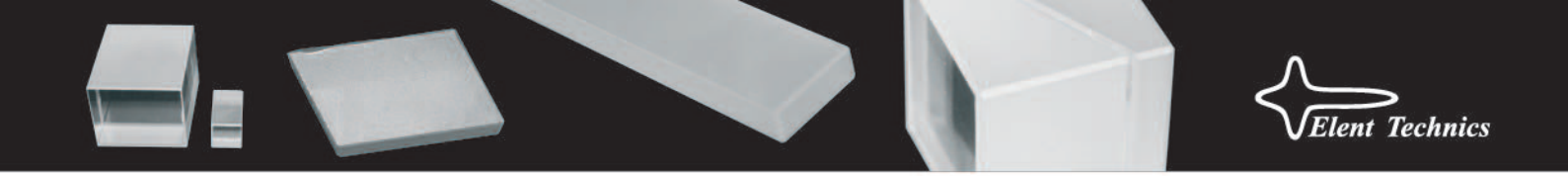
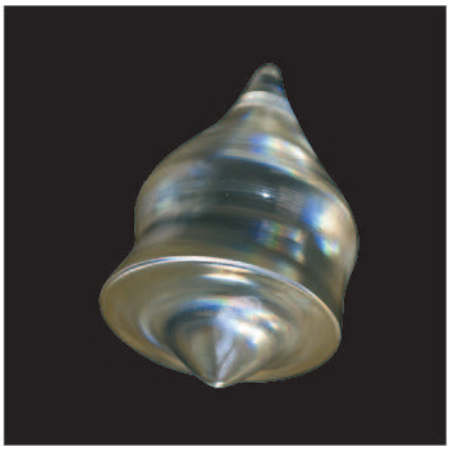



# $PbMoO_4$ - Acousto-Optical birefringent crystal

**Application – AO modulators (telecommunication), AO deflectors (2D scanning), AO Tunable Filters (spectral analysis), polarizing optics**

- Czochraiski growth method
- High laser quality and uniformity of all crystal volume
- No bubbles, Inclusions, striaes and mechanical stresses
- Minimum scattering on microdefects



| Specification | |
|---|---|
| Material | $PbMoO_4$ - light yellow, yellow orange, etc, synthetic single crystal |
| Symmetry | Tetragonal 4/m $(\bar{4})$ |
| Lattice distances | a=5.435 A; c=12.11 A |
| Molecular weight | 367.1 |
| Density, g/cm³ | 6.95 |
| Melting point | 1065 |
| Transmission | 0.42 – 5.55 µm |

# Te - Acousto-Optical crystal

**Application – AO modulators (telecommunication), AO deflectors AO Tunable Filters (spectral analysis)**

- Bridgmann growth method

| Specification | |
|---|---|
| Material | Te - silver gray |
| Symmetry | Trigonal 32 (D3) |
| Lattice distances | a=4.457 A; c=5.929 A |
| Molecular weight | 127.6 |
| Density, g/cm³ | 6.25 |
| Melting point | 450 |
| Transmission | 4-20 µm |

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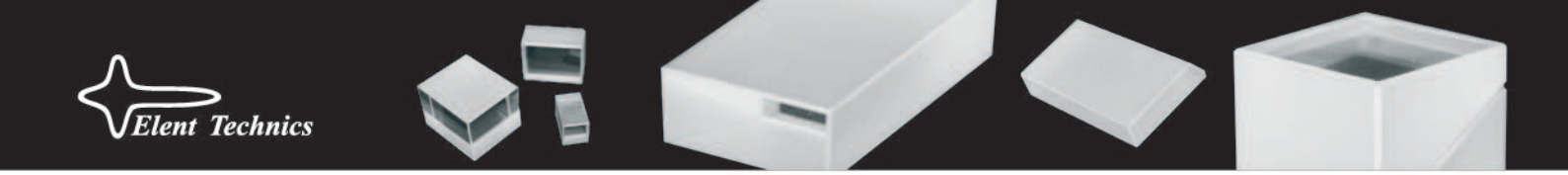


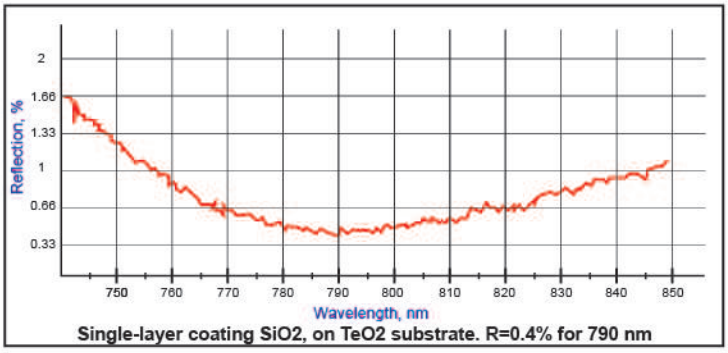
Elent Technics

# Coating thin films. AntiReflection, Protective & Metal | TF

**Thin film coating by vacuum sputering**
**Application -all optics, metal contacts for electrodes**

- E-beam & thermal sputtering
- Thickness monitor with Quartz Crystal thickness sensor
- 4" Wafer/Sample Stage (Accommodates Up to One 4" Wafer or multiple samples within 4" diameter range)

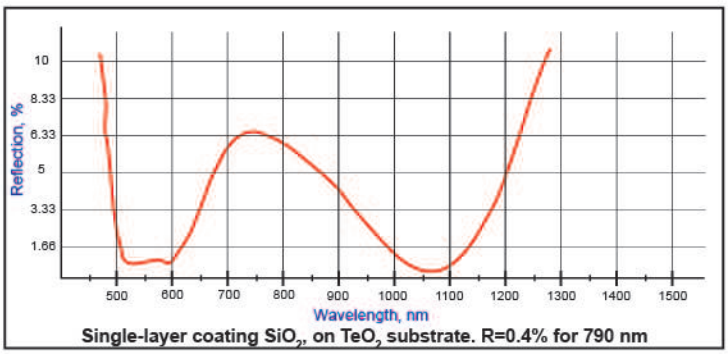
| Specification | |
|---|---|
| Substrate materials | $TeO_2$, $LiNbO_3$, Quartz, Glasses |
| Evaporation dielectric materials | $Al_2O_3$, $SiO_2$, $HfO_2$, MgF, $YrF_3$ |
| Evaporation metallic materials | Au, Cr, Ag, Cu, Ni, Sn, In |
| Number of deposited layers | 1-5 |



Single-layer coating SiO2, on TeO2 substrate. R=0.4% for 790 nm

## AR coating for single wavelength

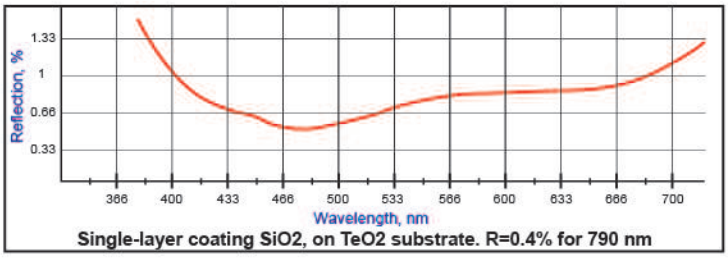
Single layer coating
$Al_2O_3$, $SiO_2$ makes coating protective
Multi layer coating
Protective outer layer $Al_2O_3$ or $SiO_2$
Layer thinckness is calculated to obtain minimum reflection of all system
Application - all kind single-wave laser optics
Typical Reflection index <0,5%



Single-layer coating $SiO_2$, on $TeO_2$ substrate. R=0.4% for 790 nm

## AR coating for two wavelengths

Multi layer coating
Standard 4 layers coating usually consisting of $Al_2O_3$, $SiO_2$, $HfO_2$, MgF
Application - second harmonic generation
Typical Reflection index for first harmonic <0,5%, for second harmonic <1%



Single-layer coating SiO2, on TeO2 substrate. R=0.4% for 790 nm

## AR coating for wideband wavelength

Multi layer coating
Up to 5 layers
Application - spectral devices and image optics
Typical Reflection index <1%

## Metallic electrodes coating

- Deposit on any substrate. Basic system: Cr-Au with a thickness of 100-3000 Å, respectively. On request, any other combination is also possible.

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