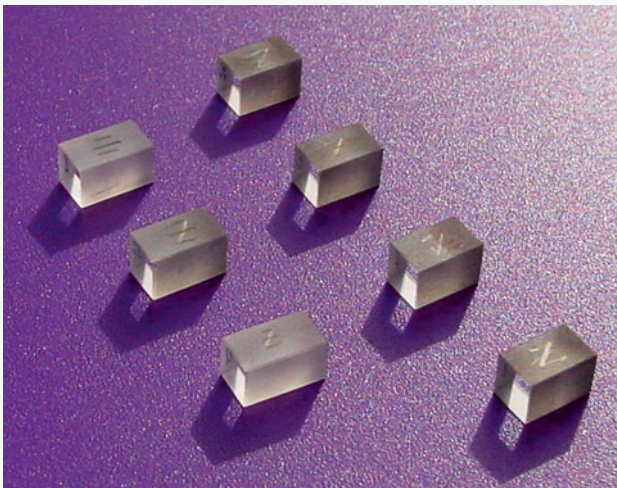


Potassium Titanyl Phosphate – KTP



KTP (KTiOPO_4) is a nonlinear optical crystal, which possesses excellent nonlinear, electrooptical and acousto-optical properties. A combination of high nonlinear coefficient, wide transparency range, and broad angular as well as thermal acceptances makes KTP very attractive for different nonlinear optical and waveguide applications. EKSPLA offers different kinds of KTP crystals depending on required application: KTP for extracavity systems (**Ex-KTP**), KTP for Intracavity (**In-KTP**) and KTP with High Gray Tracking Resistivity (**HGTR KTP**).

Ex-KTP is standard crystal with the parameters mostly used in extracavity configuration when the single pass through the crystal is required.

In-KTP crystals are optimised for SHG intracavity configuration in low peak power CW lasers. Because of large number of passes through the crystal low insertion losses and high homogeneity are essential for crystal efficiency. The special highest quality material selected by SHG efficiency mapping of each crystal, fine surface polishing and dual band AR coatings with very low losses allow EKSPLA to produce KTP crystals suitable for intracavity SHG application.

HGTR KTP is the new crystal type grown by special recently implemented technology. It has almost 2 times larger damage and gray tracking thresholds allowing to use HGTR KTP in high power lasers.

Transparency band edges of KTP crystal are at $0.35 \mu\text{m}$ in UV and at $3.5 \mu\text{m}$ in IR region. The phase-matching range of KTP crystal lies in $0.99\text{--}3.3 \mu\text{m}$ region. This allows to use KTP as intracavity and extracavity frequency doubler for the most commonly used lasers, such as Nd:YAG, Nd:YVO and Nd:YLF⁽¹⁾.

EKSPLA offers:

- Crystal size up to $10 \times 10 \times 15 \text{ mm}$ or $5 \times 5 \times 20 \text{ mm}$
- Singleband and dualband AR and BBAR coatings
- Standard and customised mounts and housings
- Free technical consulting.

EKSPLA guarantees:

- Accurate quality control
- One month customer's satisfaction term
- Conformity of crystal specifications to highest standards
- Attractive prices
- Fast delivery.

Fig. 1 represents Type 2 SHG tuning curve of KTP in x-y plane. In x-y plane the slope $\partial(\Delta k)/\partial\theta$ is small. This corresponds to quasi-angular noncritical phase-matching, which ensures the double advantage of a large acceptance angle and a small walk off. Otherwise in x-z plane the slope $\partial(\Delta k)/\partial\lambda$ is almost zero for wavelengths in the range $1.5\text{--}2.5 \mu\text{m}$ and this corresponds to quasi-wavelength noncritical phase-matching, which ensures a large spectral acceptance (see Fig. 2). Wavelength noncritical phase-matching is highly desirable for frequency conversion of short pulses.

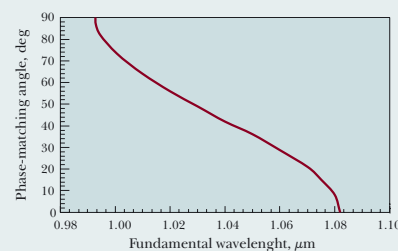


Fig. 1. Type 2 SHG in x-y plane

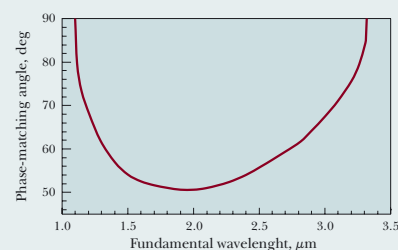


Fig. 2. Type 2 SHG in x-z plane

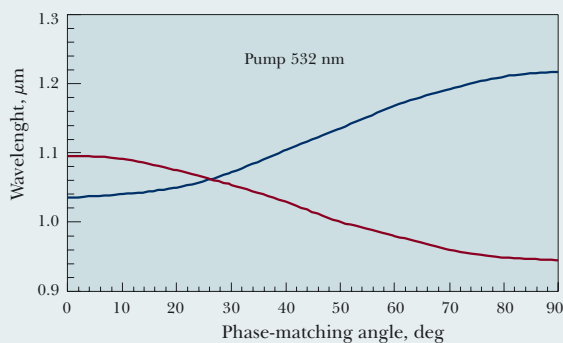


Fig. 3. OPO tuning curve in x-y plane

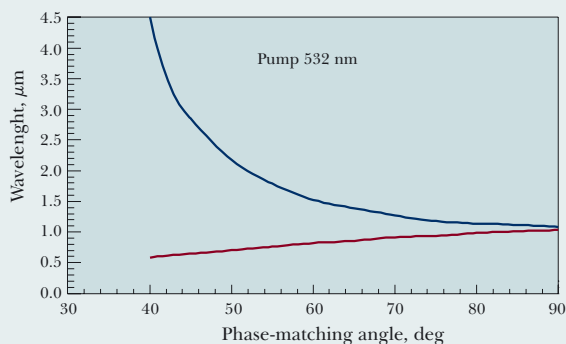


Fig. 4. OPO tuning curve in x-z plane

As a lasing material for OPG, OPA or OPO, KTP can most usefully be pumped by Nd lasers and their second harmonic or any other source with intermediate wavelength, such as a dye laser (near 600 nm). Fig. 3 and Fig. 4 shows the phase-matching angles for OPO/OPA pumped at 532 nm in x-y and x-z plane respectively.

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* Unreferenced data were determined by EK SPLA.

PHYSICAL PROPERTIES

Crystal structure ⁽²⁾	orthorhombic
Point group ⁽²⁾	mm
Space group ⁽²⁾	Pna2 ₁
Lattice constants [Å]	a=12.814, b=6.404, c=10.616
Density [g/cm ³]	3.0
Melting point ⁽³⁾ [°C]	1150
Transition temperature ⁽³⁾ [°C]	936
Mohs hardness	5
Thermal expansion coefficients ⁽³⁾ [°C ⁻¹]	a ₁ =11×10 ⁻⁶ , a ₂ =9×10 ⁻⁶ , a ₃ =0.6×10 ⁻⁶
Thermal conductivity ⁽³⁾ [W/cm°C]	k ₁ = 2.0×10 ⁻² , k ₂ = 3.0×10 ⁻² , k ₃ = 3.3×10 ⁻²
Not hygroscopic	

OPTICAL PROPERTIES

Transparency	350÷4400 nm	
Refractive indices	at 1064 nm	at 532 nm
	n _x = 1.7400	n _x = 1.7787
	n _y = 1.7469	n _y = 1.7924
	n _z = 1.8304	n _z = 1.8873
Thermo-optic coefficients in 0.4 ÷ 1.0 μm range ⁽⁴⁾	$dn_x/dT = 1.1 \cdot 10^{-5} (K)^{-1}$ $dn_y/dT = 1.3 \cdot 10^{-5} (K)^{-1}$ $dn_z/dT = 1.6 \cdot 10^{-5} (K)^{-1}$	

Wavelength dispersion of refractive indices⁽⁴⁾

$$n_x^2 = 2.1146 + 0.89188 / (1 - (0.20861/\lambda)^2) - 0.01320\lambda^2$$

$$n_y^2 = 2.1518 + 0.87862 / (1 - (0.21801/\lambda)^2) - 0.01327\lambda^2$$

$$n_z^2 = 2.3136 + 1.00012 / (1 - (0.23831/\lambda)^2) - 0.01679\lambda^2$$

NONLINEAR PROPERTIES


Phase matching range for:	
Type 2 SHG in x-y plane	0.99÷1.08 μm
Type 2 SHG in x-z plane	1.1÷3.4 μm
Walk-off for SHG @ 1.06 μm	1 mrad
Angular acceptances for SHG @ 1064 nm:	Δθ = 75 mrad Δφ = 18 mrad
Thermal acceptance ⁽³⁾	25 K×cm

Up to 80% extracavity SHG efficiency

Effective nonlinearity⁽⁴⁾

x-y plane	$d_{coe} = d_{oec} = d_{15} \sin^2 \varphi + d_{24} \cos^2 \varphi$
x-z plane	$d_{oec} = d_{coo} = d_{24} \sin \theta$
	$d_{31} = \pm 1.95 \text{ pm/V}$ $d_{32} = \pm 3.9 \text{ pm/V}$
	$d_{33} = \pm 15.3 \text{ pm/V}$ $d_{24} = d_{32}$
	$d_{15} = d_{31}$

Damage threshold >500 MW/cm²
for pulses λ=1064 nm, τ=10 ns, 10 Hz, TEM₀₀



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