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Potassium Titanyl Phosphate - KTP

- The most popular application is as a frequency doubler utilizing the 1064nm output of a Nd:YAG laser.
- The conversion efficiency to 532nm is up to 60% at 250 MW / cm2 .
- Non-hygroscopic
- Typical crystal sizes by the hydrothermal process: 15 mm x 20mm x 40 mm

※Export or re-export of this product may require U.S. Government approval.

Physical Chemical Properties	
Formula:	$KTiOPO_4$
Crystal Structure:	Orthorhombic, Space Group Pna 2_1
Lattice Parameters:	a = 12.81Å b = 6.404Å c = 10.616Å
Melting Point:	~ 1150°C with partial decomposition
Mohs Hardness:	~ 5
Color:	colorless
Density (X-Ray):	3.03 g / cm^3
Specific Heat:	0.1737 cal / gm°C
Thermal Conductivity:	k_1= 2.0, k_2= 3.0, k_3= 3.3 (x1 0^{-2} W / cm / °C)
Absorption Loss @ 1.064 µm:	< 1% / cm

Nonlinear Properties	
Nonlinear Optical Coefficients (x 10^{12} m / V):	d_{31} = 6.5, d_{32} = 5.0, d_{33} = 13.7, d_{24} = 7.6, d_{15} = 6.1
Refractive Indices @ 1.064 µm:	n_x = 1.740, n_y = 1.747, n_z = 1.830
Refractive Indices @ .532 µm:	n_x = 1.779, n_y = 1.792, n_z = 1.887
Type Phase Matching:	Type II
Phase Matching Angle (@1.064 µm):	24° to x in xy plane
Spectral Bandwidth (Å - cm):	5.6
Angular Bandwidth (mrad - cm):	15 - 68
Temperature Bandwidth (°C - cm):	25
Walk-off Angle (mrad):	1

Crystal Properties of KTP

Structural:
KTP is orthorhombic in structure and belongs to the accentric point group mm2. Its complicated structure is characterized by chains of TiO6 octahedra linked at two corners by alternating long and short Ti-O bonds that give rise to the large nonlinear optical effects observed in KTP. The constant growth rate of the hydrothermal process insures homogeneity throughout the crystal bulk

Optical:
KTP possesses optical properties that allow it to be used for both intra- and extracavity laser applications. It is optically transparent from 0.35 um to 3.5 um. The optical spectrum is structure-free except for traces of OH- absorption bands observed at 2.8 um and 3.8 um. Crystals with little or no scatter have been produced with very low strain. Damage thresholds have been measured well in excess of1 GW/cm2 . The refractive indices vary slowly with changes in wavelength and temperature.

Nonlinear Optical:
The nonlinear optical coefficients are comparable to those of Ba2NaNb501 5 and KTP can be phase matched at 1.06 um using either Type I or Type II interactions. In Type II interactions, KTP has large angular and temperature bandwidths as well as high nonlinear coefficients and damage thresholds. It has a high conversion efficiency for second harmonic generation (SHG) of laser light with fundamental wavelengths between .994 and 2.5 um.

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This material is also well suited for use as an optical parametric oscillator (OPO). KTP's wide tuning range and high conversion efficiencies mean that short crystals can be used in this application. Another application well suited for KTP is quasi phase matching (QPM). In this process z-oriented waveguides of KTP are periodically poled and pumped with diode lasers to generate blue to near UV wavelengths*.

Electro-Optical (E-O):

KTP possesses E-O properties comparable to those of $LiNbO_3$ for bulk modulator applications with a figure of merit ($n^7 r^2 / \varepsilon$) of 3650 $(pm/v)^2$. KTP is also a superior material for waveguide E-O modulators with a figure of merit ($n^3 r/\varepsilon_{eff}$) of 17.3 pm/v. When these properties are coupled with KTP's high damage threshold, wide optical bandwidth (>15GHz), thermal and mechanical stability, the combination makes it a unique material for modulator applications.

Applications:

KTP's unique combination of properties (high nonlinear coefficients, high damage threshold and non-hygroscopicity) make it well suited for laser system applications requiring high power, high efficiency and/or durability. Commercial and military applications range from medical, industrial and laboratory systems to rangefinders, designators and systems used in the semi-conductor industry. Export and re-export of this product may require U.S. Government approval.

*Ref. "W.P. Risk and S.D. Lau, Opt. Lett., vol. 18, p. 272, 1993."