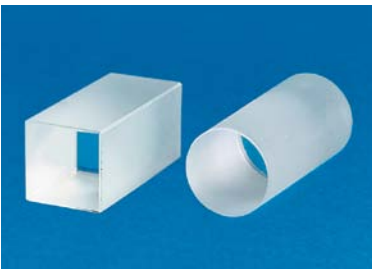


KDP • DKDP POTASSIUM DIDEUTERIUM PHOSPHATE



APPLICATIONS

- Laser frequency conversion – harmonic generation for high pulse energy, low repetition (<100 Hz) rate lasers;
- Electro-optical modulation;
- Q-switching crystal for Pockels cells.

ELECTRO-OPTICAL/Q-SWITCHING APPLICATION

- EK SMA OPTICS offers highly deuterated D>96% **electro-optic crystal – DKDP** for Q-switching application;
- Standard dimensions of **electro-optic DKDP crystals** for Q-switching are cylinders dia 9×20 mm and dia 12×24 mm however manufacturing of custom size and rectangular shape crystals is available;
- Gold evaporated or silver paste electrodes are available;
- **Dielectric thin film AR coatings** for specified laser wavelengths are available;
- Typical quarter wave voltage 3.4 kV at 1064 nm;
- Typical contrast ratio between crossed polarizers better than 1:2000;
- Damage threshold of AR coated DKDP surface >5 J/cm² at 1064 nm, 10 ns pulses.

FREQUENCY CONVERSION APPLICATIONS

- **DKDP crystals** are used for second harmonic generation of high pulse energy low repetition rate (<100 Hz) Q-switched and mode-locked Nd:YAG lasers. Cut angle of crystal for operation at room temperature is 36.6° for Type 1 phase matching and 53.7° deg for Type 2 phase matching.
- **DKDP crystals** are used for third harmonic generation of high pulse energy Q-switched and mode-locked Nd:YAG lasers via sum frequency generation. Cut angle of crystal for operation at room temperature is 59.3° for Type 2 phase matching.
- Type 1 **DKDP crystals** with non-critical cut angle $\theta=90^\circ$ are used for fourth harmonic generation (532 nm → 266 nm) of high pulse energy Q-switched and mode-locked Nd:YAG lasers. Crystal must be heated at ~50 °C temperature to match NCPM conditions.
- Type 1 **KDP crystals** with close to non-critical cut angle $\theta=76.5^\circ$ are used for fourth harmonic generation (532 nm → 266 nm) of high pulse energy Q-switched and mode-locked Nd:YAG lasers. KDP has lower absorption at UV wavelengths comparing to DKDP.
- **KDP thin crystals** are used for second harmonic generation of Ti:Sapphire laser radiation or pulse duration measurement in single shot autocorrelators. KDP possesses ~2.4 times larger spectral acceptance and correspondingly smaller group velocity mismatch comparing to BBO crystal for SHG of 800 nm, what sometime is very critical parameter for femtosecond wide spectrum pulses.
- KDP crystals can be supplied by EK SMA OPTICS of aperture up to Ø80 mm. Actually KDP remains the only solution for harmonic generation of very high intensity femtosecond Ti:Sapphire lasers featuring sub-tera Watt or tera Watt peak power pulses in large >30 mm diameter beams.

PHYSICAL AND OPTICAL PROPERTIES

Crystals		KDP	DKDP
Chemical formula		KH ₂ PO ₄	KD ₂ PO ₄
Symmetry		42 m	42 m
Hygroscopicity		high	high
Density, g/cm ³		2.332	2.355
Thermal conductivity, W/cm×K		$k_{11} = 1.9 \times 10^{-2}$	$k_{11} = 1.9 \times 10^{-2}$ $k_{33} = 2.1 \times 10^{-2}$
Thermal expansion coefficients, K ⁻¹		$a_{11} = 2.5 \times 10^{-5}$ $a_{33} = 4.4 \times 10^{-5}$	$a_{11} = 1.9 \times 10^{-5}$ $a_{33} = 4.4 \times 10^{-5}$
Transmission range, μm		0.18–1.5	0.2–2.0
Residual absorption, cm ⁻¹ (at 1.06 μm)		0.04	0.005
Measured refractive index (at 1.06 μm)		$n_o = 1.4938$ $n_e = 1.4599$	$n_o = 1.4931$ $n_e = 1.4582$
Sellmeier coeff., λ – wavelength in μm		$n^2 = A + \frac{B \lambda^2}{\lambda^2 - C} + \frac{D}{\lambda^2 - E}$	
A	n_o	2.259276	2.2409
	n_e	2.132668	2.1260
B	n_o	13.00522	2.2470
	n_e	3.2279924	0.7844
C	n_o	400	126.9205
	n_e	400	123.4032
D	n_o	0.01008956	0.0097
	n_e	0.008637494	0.0086
E	n_o	0.012942625	0.0156
	n_e	0.012281043	0.0120
Nonlinear coeff. d ₃₆ , pm/V (at 1.06 μm)		0.43	0.40
Effective nonlinear coefficient		$d_{oee} = d_{36} \times \sin\theta \times \sin 2\varphi$ $d_{eoe} = d_{36} \times \sin\theta \times \cos 2\varphi$	
Laser damage threshold, GW/cm ² at 1.06 μm	Type 1	10 ps – 100	250 ps – 6
	Type 2	1 ns – 10	10 ns – 0.5
		15 ns – 14.4	

NONLINEAR CRYSTALS

LASER CRYSTALS

TERAHERTZ CRYSTALS

RAMAN CRYSTALS

POSITIONERS & HOLDERS

CRYSTAL OVENS

PHASE MATCHING ANGLES AND BANDWIDTHS FOR SHG OF 1064 nm

Crystal	KDP		DKDP	
	Type 1 ooe	Type 2 eoe	Type 1 ooe	Type 2 eoe
Type of phase matching				
Cut angle θ , deg	41.2	59.1	36.6	53.7
Acceptances for crystal of 1 cm length (FWHM):				
$\Delta\theta$ (angular), mrad	1.1	2.2	1.2	2.3
ΔT thermal, K	10	11.8	32.5	29.4
$\Delta\lambda$ spectral, nm	21	4.5	6.6	4.2
Walk off, mrad	28	25	25	25

STANDARD SPECIFICATIONS

Flatness	$\lambda/6$ at 633 nm
Parallelism	< 20 arcsec
Surface quality	20-10 scratch & dig (MIL-PRF-13830B)
Perpendicularity	< 5 arcmin
Angle tolerance	< 30 arcmin
Aperture tolerance	± 0.1 mm
Clear aperture	90% of full aperture

ADP, DADP, RDP, CDA and DCDA crystals are available upon request!

STANDARD CRYSTALS LIST

Code	Size, mm	θ , deg	ϕ , deg	Coating	Application	Price, EUR
DKDP-401	15x15x13	36.5	45	AR/AR @ 1064+532 nm	SHG @ 1064 nm, Type 1	485
DKDP-402	15x15x13	53.5	0	AR/AR @ 1064+532 nm	SHG @ 1064 nm, Type 2	485
DKDP-403	12x12x20	59.3	0	AR/AR @ 1064+532 / 355 nm	THG @ 1064 nm, Type 2	475
DKDP-404	12x12x20	53.5	0	AR/AR @ 1064 / 1064+532 nm	SHG @ 1064 nm	475
DKDP-405	15x15x20	53.5	0	AR/AR @ 1064 / 1064+532 nm	SHG @ 1064 nm	579
DKDP-406	15x15x20	59.3	0	AR/AR @ 1064+532 / 355 nm	THG @ 1064 nm	579
KDP-401	12x12x5	76.5	45	AR/AR @ 532/266 nm	SHG @ 532 nm	405
KDP-402	15x15x7	76.5	45	AR/AR @ 532/266 nm	SHG @ 532 nm	480



Wide selection of non-standard size and cut angle DKDP crystals is available at www.eksmaoptics.com



Please contact **EKSMA OPTICS** for special OEM and large volume pricing.

RELATED PRODUCTS

Nonlinear Crystal Oven CH3

See page 2.28



Nonlinear Crystal Oven CH4

See page 2.29



DKDP and KDP crystals are highly hygroscopic. CH3 and CH4 ovens help to protect hygroscopic crystals from moisture. The raised working temperature (40-60 °C) allows to extend crystal lifetime and to keep it thermostable. This helps to stabilise SHG efficiency.