KDP / DKDP – POTASSIUM DIDEUTERIUM PHOSPHATE

ELECTRO-OPTICAL/Q-SWITCHING APPLICATION
› EKSMA 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 9x20 mm and dia 12x24 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 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.

STANDARD CRYSTALS LIST

<table>
<thead>
<tr>
<th>Size, mm</th>
<th>θ, deg</th>
<th>φ, deg</th>
<th>Coating</th>
<th>Application</th>
<th>Catalogue number</th>
<th>Price, EUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>15x15x13</td>
<td>36.5</td>
<td>45</td>
<td>AR/AR @ 1064+532 nm</td>
<td>SHG @ 1064 nm, Type 1</td>
<td>DKDP-401</td>
<td>485</td>
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<tr>
<td>15x15x13</td>
<td>53.5</td>
<td>0</td>
<td>AR/AR @ 1064+532 nm</td>
<td>SHG @ 1064 nm, Type 2</td>
<td>DKDP-402</td>
<td>485</td>
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<tr>
<td>12x12x20</td>
<td>59.3</td>
<td>0</td>
<td>AR/AR @ 1064+532 / 355 nm</td>
<td>THG @ 1064 nm, Type 2</td>
<td>DKDP-403</td>
<td>475</td>
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<tr>
<td>12x12x20</td>
<td>53.5</td>
<td>0</td>
<td>AR/AR @ 1064 / 1064+532 nm</td>
<td>SHG @ 1064 nm</td>
<td>DKDP-404</td>
<td>475</td>
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<tr>
<td>15x15x20</td>
<td>53.5</td>
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<td>AR/AR @ 1064 / 1064+532 nm</td>
<td>SHG @ 1064 nm</td>
<td>DKDP-405</td>
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<td>AR/AR @ 1064+532 / 355 nm</td>
<td>THG @ 1064 nm</td>
<td>DKDP-406</td>
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<tr>
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<td>76.5</td>
<td>45</td>
<td>AR/AR @ 532/266 nm</td>
<td>SHG @ 532 nm</td>
<td>KDP-401</td>
<td>405</td>
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<td>15x15x7</td>
<td>76.5</td>
<td>45</td>
<td>AR/AR @ 532/266 nm</td>
<td>SHG @ 532 nm</td>
<td>KDP-402</td>
<td>480</td>
</tr>
</tbody>
</table>

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

Crystals | KDP | DKDP
--- | --- | ---
Chemical formula | K_2HPO_4 | KD_2PO_4
Symmetry | 42 m | 42 m
Hygroscopicity | high | high
Density, g/cm³ | 2.332 | 2.355
Thermal conductivity, W/cm·K | k_{11} = 1.9×10⁻² | k_{11} = 1.9×10⁻²
Thermal expansion coefficients, K⁻¹ | a_{11} = 2.5×10⁻¹ | a_{11} = 1.9×10⁻⁵
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_b = 1.4938 | n_b = 1.4931
| n_a = 1.4599 | n_a = 1.4582
Sellmeier coeff., λ – wavelength in μm | n² = A + B/λ² – C + D/λ⁴
| A | n_a = 2.259276 | n_a = 2.2409
| n_a = 2.132668 | n_a = 2.1260
| B | n_b = 13.00522 | n_b = 2.2470
| n_b = 3.2279924 | n_b = 0.7844
| C | n_b = 400 | 126.9205
| n_b = 400 | 123.4032
| D | n_a = 0.01008956 | n_a = 2.7821234
| n_a = 0.008637494 | n_a = 0.0086
| E | n_a = 0.012942625 | n_a = 0.01156
| n_a = 0.012881043 | n_a = 0.0120
Nonlinear coeff. d_{36}, pm/V (at 1.06 μm) | 0.43 | 0.40
Effective nonlinear coefficient | Type 1 oo = d_{36} × sinθ × sin²φ
| Type 2 ee = d_{36} × sinθ × cos²φ
Laser damage threshold, GW/cm² at 1.06 μm | 10 ps – 100
1 ns – 10
15 ns – 14.4
250 ps – 6
10 ns – 0.5

PHASE MATCHING ANGLES AND BANDWIDTHS FOR SHG OF 1064 nm

<table>
<thead>
<tr>
<th>Crystal</th>
<th>KDP</th>
<th>DKDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of phase matching</td>
<td>Type 1 oo</td>
<td>Type 2 ee</td>
</tr>
<tr>
<td>Cut angle θ, deg</td>
<td>41.2</td>
<td>59.1</td>
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<tr>
<td>Acceptances for crystal of 1 cm length (FWHM):</td>
<td></td>
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<tr>
<td>Δθ (angular), mrad</td>
<td>1.1</td>
<td>2.2</td>
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<tr>
<td>ΔT thermal, K</td>
<td>10</td>
<td>11.8</td>
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<td>Δλ spectral, nm</td>
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<td>4.5</td>
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<tr>
<td>Walk off, mrad</td>
<td>28</td>
<td>25</td>
</tr>
</tbody>
</table>

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

RELATED PRODUCTS

Nonlinear Crystal Oven CH8
See page 2.30

DKDP and KDP crystals are highly hygroscopic. CH8 and CH9 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.