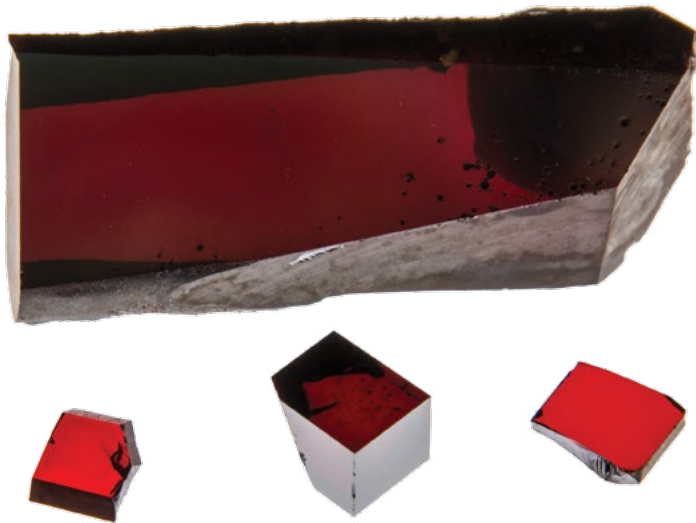


Cadmium silicon phosphide

Non-linear optical crystal



Cadmium Silicon Phosphide (CdSiP_2) is a new nonlinear optical crystal for frequency conversion in the 1–8 μm spectral range with the ability to pump at wavelengths shorter than 2 μm .

These crystals developed by BAE Systems revealed the largest nonlinear coefficient for a phase-matchable inorganic crystal in forty years.

Features

- High nonlinear coefficient: $d_{36} = 84.5 \text{ pm/V}$
- High thermal conductivity: 13.6 W/m-K
- Band gap at 2.45 eV (506 nm)
- Birefringence allows for most phase-matching interactions over transparency range while producing minimal walkoff
- Thermal and mechanical robustness

Benefits

- Enables efficient frequency conversion
- Allows high-power operation without significant thermal lensing
- Allows for pumping at 1.06 μm without two-photon absorption
- Converts wavelengths as short as 1.06 μm into other wavelengths over the 1–8 μm transparency window
- Allows for straightforward fabrication of device-oriented crystals
- Available in large apertures for high energy applications

Applying innovative techniques to create high-quality optical crystals

Crystallographic data

| | |
|------------------------------------|--------------------|
| Chemical formula | CdSiP ₂ |
| Structure | Chalcopyrite |
| Crystal class and symmetry | Tetragonal (42m) |
| Lattice constants (Å) | a=5.68, c=10.431 |
| X-ray density (g/cm ³) | 4.70 |

Thermo-mechanical properties

| | |
|--|-----------------------|
| Hardness H, (kg/mm ²) | 930 |
| Melting point (°C) | 1133 |
| Specific heat (J/g-K) | 0.446 |
| Thermal conductivity (W/m-K) | 13.6 |
| Thermal expansion coefficient (10 ⁻⁶ °C ⁻¹) | -2.8 (c), 10.2 (⊥c) |

Optical properties

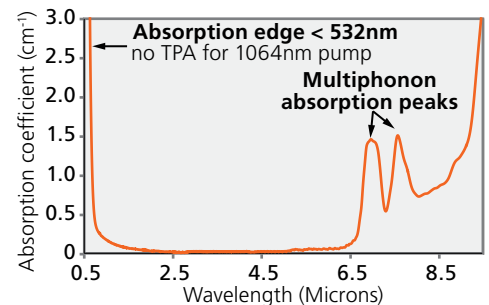
| | | |
|--|----------------|----------------|
| Transparency range (μm) ^a | 0.53 to 9.5 | |
| Nonlinear coefficient, d ₃₆ (pm/V) | 84.5 | |
| Refractive index ^b | n _o | n _e |
| 1.0 μm | 3.177 | 3.128 |
| 2.0 μm | 3.085 | 3.033 |
| 4.0 μm | 3.057 | 3.006 |
| 5.0 μm | 3.050 | 2.998 |
| Sellmeier coefficients (n ² = A + (Bλ ²) / (λ ² - C) + Dλ ²) | n _o | n _e |
| A | 3.0811 | 3.4343 |
| B | 6.2791 | 5.6137w |
| C | 0.10452 | 0.11609 |
| D | -0.0034888 | -0.0034264 |
| Absorption coefficient, α (cm ⁻¹) | o pol. | e pol. |
| 1.06 μm | 0.12 | 0.16 |
| 2.05 μm | 0.009 | 0.006 |
| 2.35 μm | <0.001 | <0.001 |
| Laser-damage threshold (J/cm ²) | >1.0 | |

Sample size and orientation

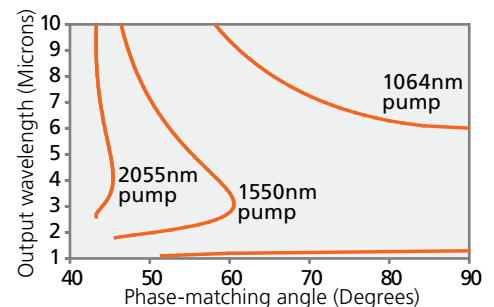
Standard cut is for type I phase matching, φ=45° (Type II, φ=0° is also available)
Standard dimensions are 6mm x 6mm x 10 mm³ (other sizes available)

NOTES: ^a Range over which the absorption coefficient, α, is below 3 cm⁻¹.

^b n_o = ordinary polarized (E⊥c), n_e = extra-ordinary polarized (E||c)



Optical absorption



Type I phase-matching curves for three different pump sources

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