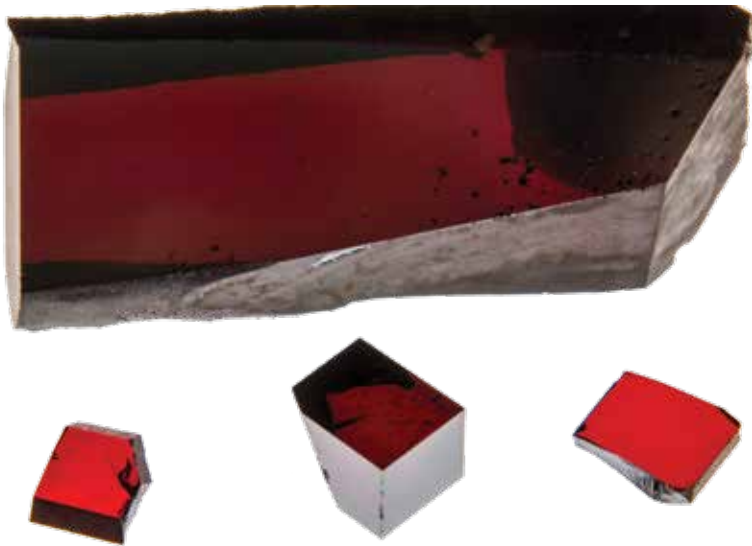


# Cadmium silicon phosphide

Non-linear optical crystal



Cadmium Silicon Phosphide ( $\text{CdSiP}_2$ ) is a new nonlinear optical crystal for frequency conversion in the 1–8  $\mu\text{m}$  spectral range with the ability to pump at wavelengths shorter than 2  $\mu\text{m}$ .

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:  $13.6 \text{ W/m-K}$

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  $\mu\text{m}$  without two-photon absorption

Converts wavelengths as short as 1.06  $\mu\text{m}$  into other wavelengths over the 1–8  $\mu\text{m}$  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

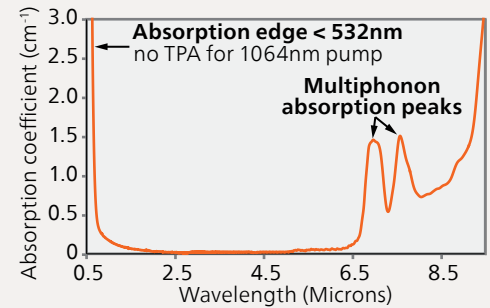
Chemical formula	CdSiP <sub>2</sub>
Structure	Chalcopyrite
Crystal class and symmetry	Tetragonal (42m)
Lattice constants (Å)	a=5.68, c=10.431
X-ray density (g/cm <sup>3</sup> )	4.70

## Thermo-mechanical properties

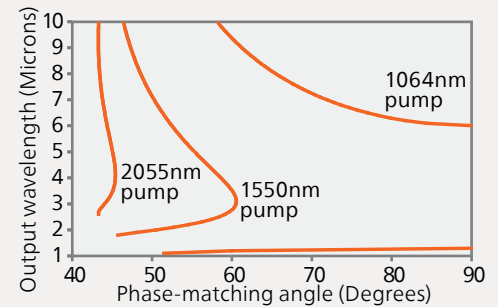
Hardness H, (kg/mm <sup>2</sup> )	930
Melting point (°C)	1133
Specific heat (J/g-K)	0.446
Thermal conductivity (W/m-K)	13.6
Thermal expansion coefficient (10 <sup>-6</sup> °C <sup>-1</sup> )	-2.8 (  c), 10.2 (⊥c)

## Optical properties

Transparency range (μm) <sup>a</sup>	0.53 to 9.5	
Nonlinear coefficient, d <sub>36</sub> (pm/V)	84.5	
Refractive index <sup>b</sup>	n <sub>o</sub>	n <sub>e</sub>
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 <sup>2</sup> = A + (Bλ <sup>2</sup> ) / (λ <sup>2</sup> - C) + Dλ <sup>2</sup> )	n <sub>o</sub>	n <sub>e</sub>
A	3.0811	3.4343
B	6.2791	5.6137w
C	0.10452	0.11609
D	-0.0034888	-0.0034264
Absorption coefficient, α (cm <sup>-1</sup> )	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 <sup>2</sup> )	>1.0	



Optical absorption



Type I phase-matching curves for three different pump sources

## Sample size and orientation

Standard cut is for type I phase matching,  $\phi=45^\circ$  (Type II,  $\phi=0^\circ$  is also available)  
Standard dimensions are 6mm x 6mm x 10 mm<sup>3</sup> (other sizes available)

NOTES: <sup>a</sup> Range over which the absorption coefficient,  $\alpha$ , is below 3 cm<sup>-1</sup>.

<sup>b</sup> n<sub>o</sub> = ordinary polarized (E⊥c), n<sub>e</sub> = extra-ordinary polarized (E||c)

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