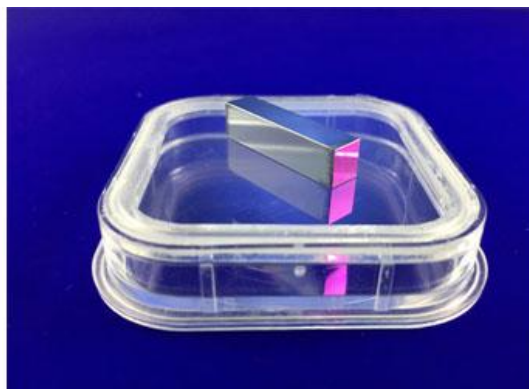


ZGP (ZnGeP₂) crystals

Zinc germanium phosphide (ZnGeP₂) is an excellent mid-IR nonlinear crystal with many outstanding fundamental properties. ZnGeP₂ (ZGP) crystal has large nonlinear susceptibility ($d_{36} \sim 75$ pm/V), which is approximately 160 times that of KDP. ZGP exhibits good optical transparency over the 0.74–12 μ m wavelength region and relatively high laser damage threshold, and is therefore well suited for producing tunable laser output in the near infrared. ZGP is a very promising material for applications such as SHG, SFG, OPO, and OPG/OPA in the mid-infrared region.



Modules or types

Typical ZGP crystals modules

Modules	Crystal dimension/mm	Application	Orientation Theta/Phi deg	Coatings
SHZGP-7515-54	7x5x15	OPO @ 2.1- 3.5-5 μ m	54/0	AR@2.1 μ m+BBAR@3.5-5 μ m
SHZGP-7520-54	7x5x20	OPO @ 2.1- 3.5-5 μ m	54/0	AR@2.1 μ m+BBAR@3.5-5 μ m
SHZGP-7525-54	7x5x25	OPO @ 2.1- 3.5-5 μ m	54/0	AR@2.1 μ m+BBAR@3.5-5 μ m

Features

Features

- Wide transmission region from 0.74 μm to 12 μm
- Large nonlinear coefficient
- Good mechanical and physical properties
- Relatively high damage threshold
- Phase matchable over a broad spectral region
- High thermal conductivity

Applications

- Second, third, and fourth harmonic generation of CO₂ laser
- Optical parametric generation (OPO) with pumping at a wavelengths of 2.05-2.94 μm and possibility to generate effectively 3-10 μm ranges
- Second harmonic generation of CO-laser
- Producing coherent radiation in sub-millimeter-range from 70.0 μm to 1000 μm - terahertz range
- Generation of combined frequencies of CO₂- and CO-lasers radiation and other lasers are working in the crystal transparency region

SPECIFICATIONS

Specifications of ZGP crystals	
Materials	ZnGeP2 crystals
Thickness/Diameter Tolerance	+/-0.05mm
Orientation Tolerance	<0.5°
Flatness	less than $\lambda/8$ @ 633nm
Transmitting wavefront distortion	less than $\lambda/4$ @ 633nm
Chamfer	$\leq 0.2\text{mm} \times 45^\circ$
Chip	$\leq 0.1\text{mm}$
Surface Quality	better than 10/5 S/D (MIL-PRF-13830B)
Parallelism	≤ 30 arc seconds
Perpendicularity	≤ 15 arc minutes
Aperture	>90%

Basic Properties

Chemical and Physical Properties	
Chemical formula	ZnGeP ₂
Crystal structure	Tetragonal, 42m
Lattice parameter	a=b=5.467Å, c=12.736Å
Mass density	4.16 g/cm ³
Moh hardness	5.5
Melting point	About 1040°C
Thermal conductivity	180 W/m/K
Thermal expansion coefficient	$\beta_{ }, 5 \times 10^{-6}/K$; $\beta_{\perp}, 7.8 \times 10^{-6}/K$
Birefringence	positive uniaxial

Linear Optical Properties	
Transparency range	0.74 - 12 μ m
Absorption coefficient:	$\alpha < 0.05 \text{ cm}^{-1}$ @2050-2100 nm
Refractive Indices	$n_o = 3.1478, n_e = 3.1891$ $n_o = 3.1333, n_e = 3.1744$ $n_o = 3.1136, n_e = 3.1547$ $n_o = 3.0729, n_e = 3.1143$
Sellmeier Equations(λ in μ m)	$n_o^2(\lambda) = 4.64467 + 5.10087/(\lambda^2 - 0.13656) + 4.27777\lambda^2/(\lambda^2 - 1653.89)$ $n_e^2(\lambda) = 4.71539 + 5.26358/(\lambda^2 - 0.14386) + 2.37310\lambda^2/(\lambda^2 - 1000.82)$

Nonlinear Optical Properties	
SHG Phase Matchable	3177 ~ 10357nm (Type I)
NLO coefficients	$d_{36} = 75 \pm 8 \text{ pm/V}$ Type I $d_{eoo} = d_{36} \sin^2\theta \cos 2\phi$ Type II $d_{oee} = d_{eoo} = d_{36} \sin\theta \sin 2\phi$
Damage Threshold	30 GW/cm ² (150 ps) 1 GW/cm ² (2 ns)

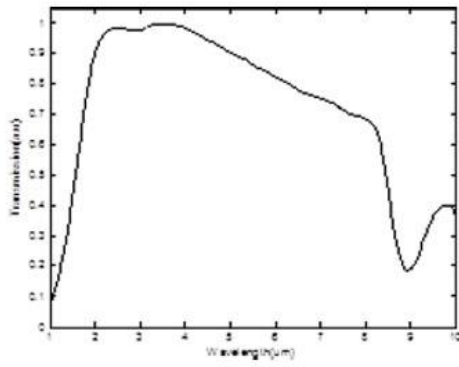
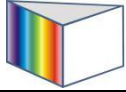


Fig 1. The Transmission spectra of 15 mm long AR coated ZnGeP2 crystal

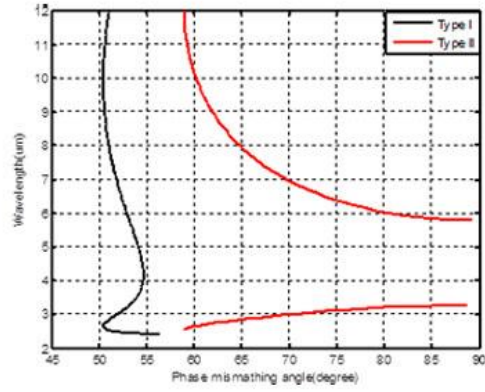


Fig 2. OPO tuning curves of ZGP with pump light of 2090 nm

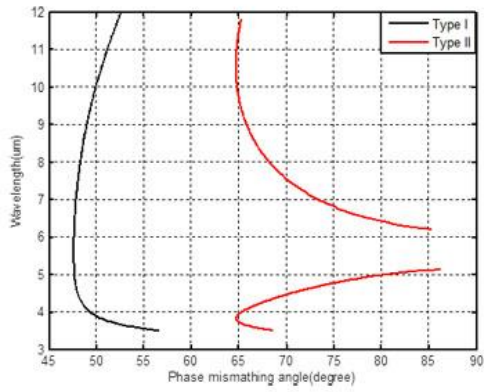


Fig 3. OPO tuning curves of ZGP with pump light of 2800 nm

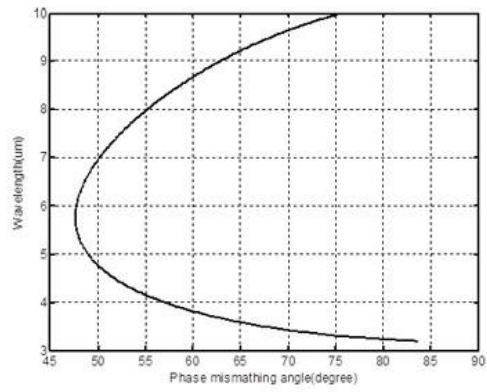


Fig 4. SHG curves of ZGP (Type I (eoo))