ZGP (ZnGeP2) Nonlinear Crystal for Mid-IR OPO, 0.75–12 µm

Model WQ-NLC-ZGP · waveqvanta.com/products/zgp-zngep2-nonlinear-crystal

ZGP (zinc germanium phosphide, ZnGeP2) is a mid-infrared nonlinear crystal combining a large nonlinear coefficient (d36 = 75 pm/V at 9.6 µm), transparency from 0.75 to 12 µm and a thermal conductivity of about 35 W/(m·K). Its low absorption at 2.0–2.1 µm makes it widely used in 2 µm-pumped OPO and OPA sources tuned across the mid-IR. WaveQuanta supplies ZGP in two grades, C-ZGP and the lower-absorption YS-ZGP, in standard and custom orientations.



Key features

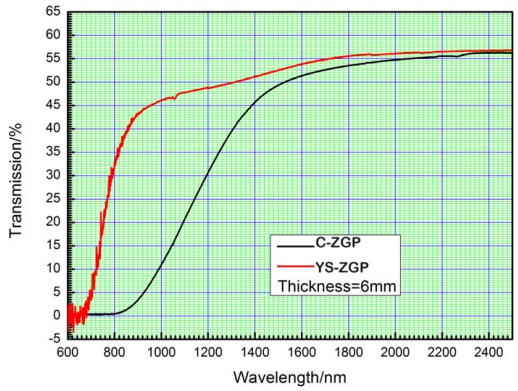
- Nonlinear coefficient d36 = 75.0 pm/V at 9.6 µm (68.9 pm/V at 10.6 µm)
- Transparency range 0.75–12 µm; useful transmission range 2.0–10.0 µm
- Absorption at 2090 nm below 0.05 cm^{-1} for C-ZGP; YS-ZGP has lower absorption, better homogeneity and higher output efficiency
- Thermal conductivity 35 W/(m·K) ⊥c and 36 W/(m·K) ∥c at 293 K, suited to high-average-power operation
- Laser damage threshold 2–5 J/cm^2
- Mohs hardness 5.5 with good machinability
- Standard type I cut at θ = 54° for OPOs pumped at 2.05–2.1 µm with 3.0–6.0 µm output; custom orientations on request
- Standard apertures 5 × 5, 6 × 8 and 8 × 12 mm, lengths 1–50 mm

Specifications

Chemical Formula	ZnGeP2
Crystal Symmetry and Class	Tetragonal, -42m
Lattice Parameters	a = 5.467 Å, c = 12.736 Å
Density	4.162 g/cm^3
Mohs Hardness	5.5
Optical Class	Positive uniaxial
Transparency Range	0.75–12.0 µm
Useful Transmission Range	2.0–10.0 µm
Nonlinear Coefficient	d36 = 68.9 pm/V @ 10.6 µm; d36 = 75.0 pm/V @ 9.6 µm
Absorption Coefficient @ 2090 nm	< 0.05 cm^{-1} (C-ZGP); lower for YS-ZGP
Laser Damage Threshold	2–5 J/cm^2
Thermal Conductivity @ 293 K	35 W/(m·K) ⊥c; 36 W/(m·K) ∥c
Thermal Expansion (293–573 K)	17.5 $\times 10^{-6}$ /K ⊥c; 15.9 $\times 10^{-6}$ /K ∥c
Available Grades	C-ZGP; YS-ZGP (lower absorption at 2090 nm)
Standard Orientation	Type I, θ = 54° (OPO pumped at 2.05–2.1 µm, 3.0–6.0 µm output)
Standard Cross Sections	5 × 5 mm, 6 × 8 mm, 8 × 12 mm
Length Range	1–50 mm
Aperture Tolerance	±0.1 mm
Length Tolerance	±0.5 mm (length over 10 mm); ±0.1 mm (length 1–10 mm)
Surface Quality	20-10 scratch-dig

Wedge / Parallelism	< 30 arc sec
Perpendicularity	< 5 arc min

Measured data (typical)



Standard sizes

Size	Cut / orientation	Surface / coating	Mount
5 × 5 × 0.25 / 0.5 / 1 mm	θ = 51°, φ = 0°, Type I	S1: AR @ 1000–4000 nm; S2: AR @ 1500–12000 nm	—
5 × 5 × 1 / 1.5 mm	θ = 51°, φ = 0°, Type I	S1: AR @ 1000–3500 nm; S2: AR @ 3000–12000 nm	—
5 × 5 × 20 mm	θ = 67°, φ = 0°	AR/AR @ 5 μm + 10 μm	—
6 × 6 × 5 mm	θ = 48°, φ = 0°	AR/AR @ 2–3 μm + 5–9 μm	—
6 × 6 × 12 mm	θ = 59.6°, φ = 0°	AR/AR @ 1925–1945 + 1975–1995 + 3500–4500 nm	—
6 × 6 × 15 / 20 / 40 mm	θ = 54.7°, φ = 0°	AR/AR @ 2.1 μm + 3–5 μm	—
6 × 6 × 15 mm	θ = 56.5°, φ = 0°	AR/AR @ 2050 + 3500–5000 nm	—
6 × 6 × 20 mm	θ = 53.8°, φ = 0°	AR/AR @ 2–2.1 μm (R < 0.25%) + 5.8–6.8 μm (R < 1%)	—
6 × 6 × 20 mm	θ = 54.7°, φ = 0°	AR/AR @ 2090 nm (R < 0.25%) + 3–5 μm (R < 1%)	—
6 × 6 × 20 mm	θ = 55°, φ = 0°	AR/AR @ 2.05 μm + 3–5 μm	—
6 × 6 × 20 mm	θ = 56.2°, φ = 0°	AR/AR @ 1.9–2.1 μm + 3.8–4.5 μm	—
6 × 6 × 25 mm	θ = 50.4°, φ = 0°	AR/AR @ 2090 nm + 2800 nm + 8 μm	—
6 × 6 × 25 mm	θ = 50.5°, φ = 0°	AR/AR @ 2090 nm (R < 0.25%) + 3–5 μm (R < 1%)	—
6 × 6 × 25 mm	θ = 54.9°, φ = 0°	AR/AR @ 2.09 μm + 3.8–4.6 μm	—
6 × 6 × 25 mm	θ = 57.5°, φ = 0°	AR/AR @ 2.1 μm + 3–5 μm	—
6 × 6 × 27 mm	θ = 50.11°, φ = 0°	AR/AR @ 2.09 + 2.8 + 8 μm	—
6 × 6 × 27 mm	θ = 50.5°, φ = 0°	AR/AR @ 2.09 + 2.8 + 8 μm	—
6 × 6 × 27 mm	θ = 51.2°, φ = 0°	AR/AR @ 2.09 + 2.8 + 8 μm	—
6 × 6 × 30 mm	θ = 54.5°, φ = 0°	AR/AR @ 2.1 μm + 3–5 μm	—
6 × 6 × 30 mm	θ = 54.7°, φ = 0°	AR/AR @ 2090 nm + 3–5 μm	—
6 × 8 × 15 mm	θ = 54°, φ = 0°	AR/AR @ 2090 nm (R < 0.25%) + 3–5 μm (R < 1%)	—
6 × 8 × 20 mm	θ = 60°, φ = 0°	AR/AR @ 1938 + 3000–5000 nm	—
7 × 7 × 20 mm	θ = 62°, φ = 0°	AR/AR @ 1.8–4.2 μm	—
8 × 6 × 8.5 mm	θ = 55°, φ = 0°, Type I	AR/AR @ 2.09 μm (R < 0.5%) + 3.5–5 μm (R < 1%)	—
8 × 8 × 1 / 4 mm	θ = 57.5°, φ = 0°	S1: AR @ 1.3–2.6 μm; S2: AR @ 3.5–10 μm	—

Size	Cut / orientation	Surface / coating	Mount
8 × 8 × 4 / 7.5 mm	θ = 57.5°, φ = 0°	AR/AR @ 1.7–3 µm + 5–13 µm	—
8 × 8 × 20 mm	θ = 54.7°, φ = 0°	AR/AR @ 2090 nm (R < 0.25%) + 3–5 µm (R < 1%)	—
12 × 12 × 15 mm	θ = 54.7°, φ = 0°	AR/AR @ 2090 nm + 3–5 µm	—
15 × 15 × 0.5 mm	θ = 48.6°, φ = 0°	AR/AR @ 1.8–3.5 µm + 5–11 µm	—
15 × 15 × 1 mm	θ = 48.6°, φ = 0°	AR/AR @ 1.8–3.5 µm + 5–11 µm	Mounted
15 × 15 × 1.5 mm	θ = 48.6°, φ = 0°	AR/AR @ 2–3.3 µm (R < 2%) + 7–12 µm (R < 5%)	Mounted
15 × 15 × 2.5 mm	θ = 48.6°, φ = 0°	AR/AR @ 2–3.3 µm (R < 2%) + 7–12 µm (R < 5%)	—
5 × 5 × 1 mm	θ = 51°, φ = 0°	Polished, uncoated	—
6 × 6 × 0.5 mm	θ = 66°, φ = 0°	Polished, uncoated	—
6 × 6 × 25 mm	θ = 50.4°, φ = 0°	Polished, uncoated	—
6 × 6 × 30 mm	θ = 54.7°, φ = 0°	Polished, uncoated	—
6 × 8 × 20 mm	θ = 54°, φ = 0°	Polished, uncoated	—
6 × 8.5 × 0.035 mm	θ = 48.4°, φ = 0°	Polished, uncoated	—
10 × 10 × 0.1 / 0.5 / 1 mm	⟨110⟩ cut	Polished, uncoated	Mounted
12 × 12 × 15 mm	θ = 54.7°, φ = 0°	Polished, uncoated	—

Typical applications

- Mid-IR OPO and OPA pumped near 2 µm, tunable in the 3–6 µm range
- Second, third and fourth harmonic generation of CO2 lasers
- Second harmonic generation of CO lasers
- Sum- and difference-frequency mixing of CO2, CO and other lasers operating within the transparency range
- THz and sub-millimetre-wave generation up to 1000 µm, including 1 µm-pumped schemes with YS-ZGP