YCOB $YCa_4O(BO_3)_3$

DESCRIPTION

YCOB ($YCa_4O(BO_3)_3$, Yttrium Calcium Oxyborate)—Nonlinear crystal considered to have good prospects of UV band optical frequency multiplier.

YCOB crystal is one of the most widely used nonlinear optical crystals. Its nonlinear optical coefficient is equivalent to that of BBO crystal and LBO crystal. The effective frequency multiplication coefficients of the second and third order reach 2, 8 and 1, 4 times of KDP respectively.The YCOB crystal has the following advantages : large aperture, high damage intensity in femtosecond regime,about2000-2500GW/cm^2 wide allowable Angle range and allowable temperature range,small dispersion Angle, shorter growth period by Cz method.At the same time, it has stable physical and chemical properties (non-deliquescent) and good machining properties. Therefore, it is considered to have good application prospects of blue-green light and UV band optical frequency multiplier crystal.

One of the latest technical achievements connected with YCOB is the generation of 2.35-W CW green output (λ = 532 nm) in a 1.2-cm-long crystal (θ = 64.5°, φ =35.5°) via inter cavity SHG of a diode-array end-pumped Nd:YVO4 laser (P = 5.6W). Another similar application is THG of NdYVO4 laser radiation. Using the KTP crystal for frequency doubling and a 1.1-cm-longYCOB crystal (θ = 106°, φ =77.2°), the authors managed to obtain 124mW of quasi-CW light (pulse repetition frequency 20 kHz) at 355 nm.near infrared optical parametric chirped pulse amplifiers, which currently deliver few optical cycle pulses with high average and ultrahigh peak powers.

FEATURES

- High electric resistivity
- Hightemperature acceptance
- High laser induce damage threshold
- Less anisotropy
- Smal thermal expansion coefficient
- Less parametric luminescence

APPLICATIONS

- SHG(second-harmonic generation),THG(third-harmonic generation)
- OPO(optical parametric oscillator)
- OPA(optical parametric amplification)
- OPCPA (optical parametric chirped-pulse amplification)
- Piezoelectric acceleration sensors

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PARAMETERS

PHYSICAL AND CHEMICAL PROPERTIES

Property	Value
Chemical formula	$(YCa_4O(BO_3)_3$
Crystal structure	Monoclinic, Point group m
Lattice Parameter	a=8.0770 Å,b=16.0194 Å c=3.5308 Å， β=101.167º, Z=2
Melting Point	About 1510ºC
Moh hardness	6~6.5
Density	3.31 g/cm³
Thermal conductivity	2.6 W/m/K (‖X) 2.33 W/m/K (‖Y) 3.1 W/m/K (‖Z)

EXPERIMENTAL VALUES OF EFFECTIVE SECOND-ORDER NONLINEARCOEFfiCIENTFORSOMESPECIfiC PHASE-MATCHING DIRECTIONS (SHG, TYPE I, 1.0642μm →0.5321μm) IN YCOB CRYSTAL

Phase-matching direction	d_{eff} [pm/V]
θ =90˚,Φ=35.3˚ (XY plane)	0.39
θ =90˚,Φ=35˚ (XY plane)	0.42
θ =31.7˚,Φ=0˚ (XZ plane)	1.03
θ =148.3˚,Φ=0˚ (XZ plane)	1.44
θ =65˚,Φ=36.5˚	1.14
θ =66.3˚,Φ=143.5˚	1.45
θ =66˚,Φ=145˚	1.8

The properties of deff in the case of YCOB crystal include mirror and inversion symmetries. T his means that the spatial distribution of deff can fully be described by choosing two independent quadrants, for example,(0°＜θ＜90°,0°＜Φ＜90°) and (0°＜θ＜90°,90°＜Φ＜180°).After that, the deff value in each (θ, Φ) direction in these two quadrants is equal to that in (180°-θ, 180°-Φ) direction and vice versa. For example, the directions (θ =33°, =9°) and (θ =147°, Φ=171°) possess equal deff values.

EXPERIMENTAL VALUES OF INTERNAL ANGULAR BANDWIDTHS AT T =293K

Interacting wavelengths(nm)	Φ_{pm} [deg]	θ_{pm} [deg]	$\Delta\Phi^{int}$ [deg]	$\Delta\theta^{int}$ [deg]
XY plane, θ =90˚				
SHG, o+o → e				
1064 → 532	35		0.09	
SHG, e+o → e				
1064 → 532	73.4		0.32	
SFG, o+o → e				
1064+532 → 355	73.2		0.11	
YZ plane, Φ =90˚				
SHG, e+o → e				
1064 → 532		58.7		0.74
SFG, e+e → o				
1064+532 → 355		58.7		0.19
XZ plane, Φ=0˚,θ<V_z				
SHG, o+o → e				
1064 → 532		31.7		0.08

EXPERIMENTAL VALUES OF PHASE-MATCHING ANGLE (T =293K)

Interacting wavelengths[nm]	Φ_{exp} [deg]
XY plane, θ =90˚	
SHG, o+o → e	
1064 → 532	35
738 → 369	77.3
SHG, type I, along Y	
724 → 362	90
SFG, o+o → e	
1064+532 → 355	75.2
SHG, type II, along Y	
1030 → 515	90
SFG, e+o → e	
1908+1064 → 683	81.2

www.laser-crylink.com
sales@lase-crylink.com
+86-21-69910952 / 69913696
No.200, Zhaoxian Road, Jiading District, Shanghai, China

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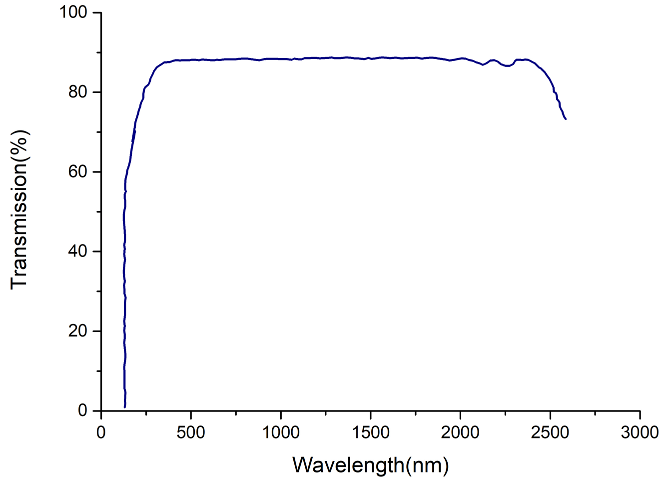
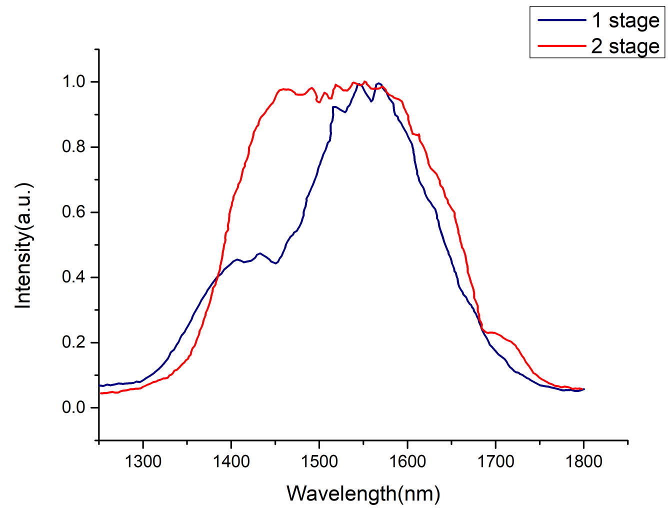
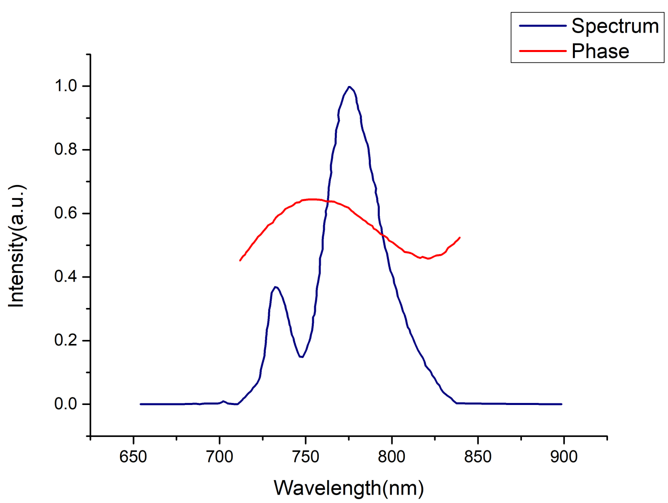
SPECTRA



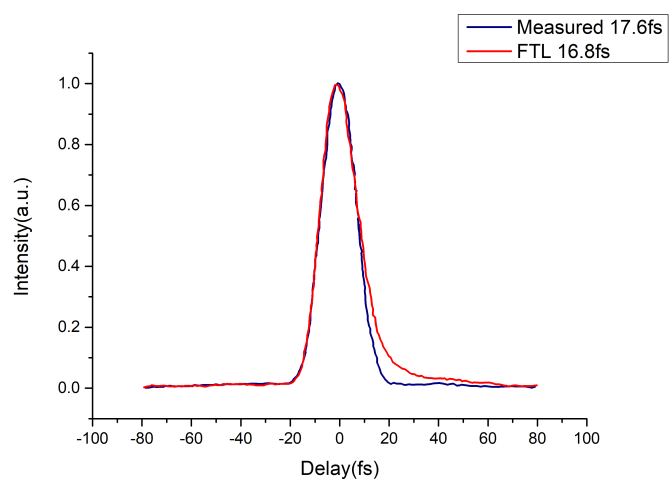
Transmission Spectrum of YCOB



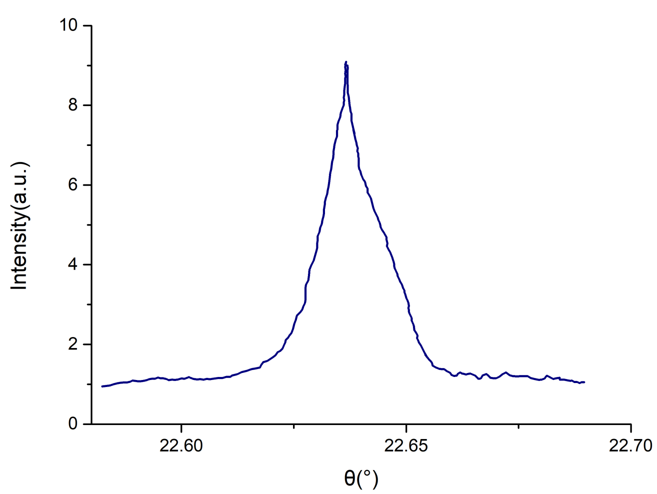
OPA spectrum of YCOB



Amplified pulse's frequency and temporal shape



Amplified pulse's frequency and temporal shape



X-ray rocking curve of YCOB wafer

www.laser-crylink.com +86-21-69910952 / 69913696
sales@lase-crylink.com No.200, Zhaoxian Road, Jiading District, Shanghai, China