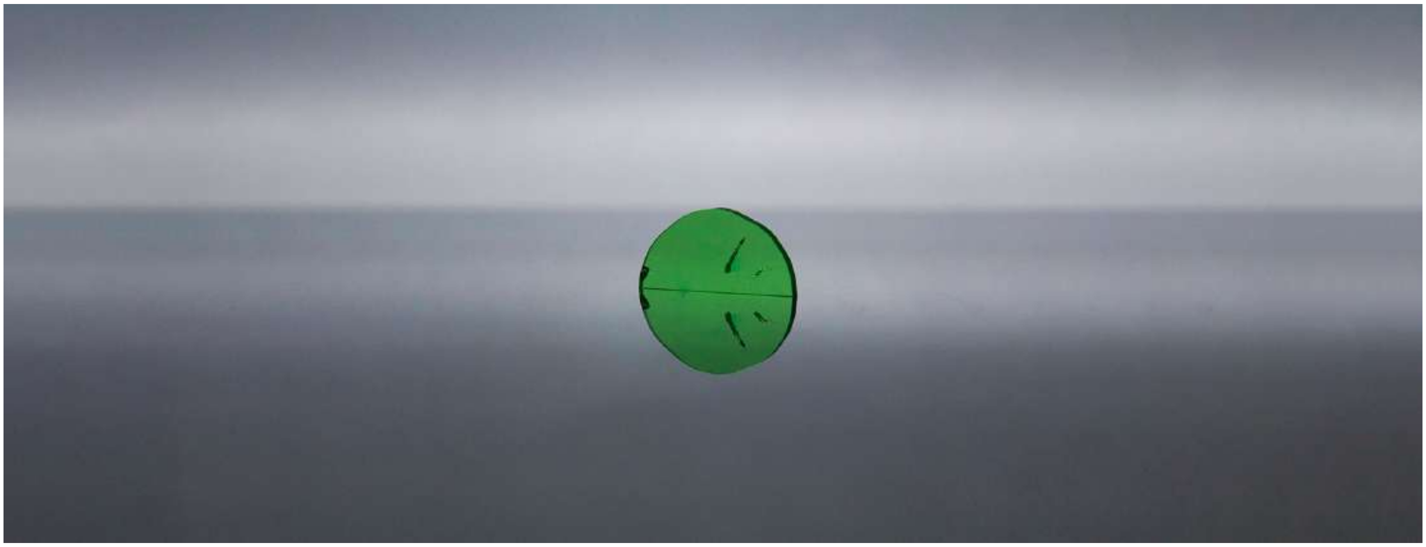
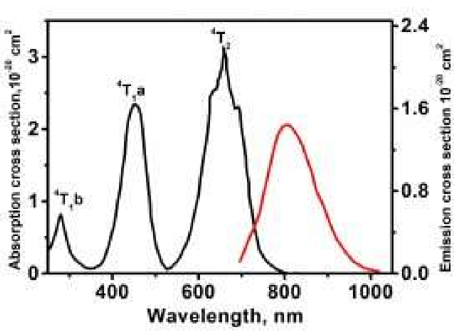
Cr:LiCAF



DESCRIPTION

LiCaA1F6:Cr3（Cr:LiCAF) is a new addition to a series of new tunable near-infrared laser materials. Cr:LiSAF possess suitable properties for the generation of high-energy tunable radiation in the near infrared. It exhibits small thermal lensing, a high damage threshold and a sufficiently long upper-state lifetime to ensure efficient energy storage. Furthermore, laser rods of diameters up to 25 mm can now be fabricated, which is an important consideration for the design of high-energy lasers and amplifiers. The relatively long upper-state lifetime Cr:LiCAF 170μs, makes it possible to efficiently pump these materials with flashlamps. The new chromium laser host, LiCAF, is reported to possess favorable spectroscopic and laser properties. Laser-quality LiCAF crystals appear to be moderately straightforward to produce: zone-melting, Bridgman, and Czochralski crystals have been lased. Significant scattering in these crystals, a persistent problem in early growth attempts, now appears to be under control. Recently used Bridgman crystals have scattering losses of ~0.1% cm−1, an acceptable level for most applications. The natural abundance of the constituent elements, coupled with the relatively low melting temperature (804°C) and congruent melting, forms a compelling case for the possibility of large-scale, inexpensive growth of laser-quality crystals. The laser emission of Cr:LiCAF has been tuned to between approximately 720 and 840nm and peaks at ~780nm. The radiative lifetime is ~175 μs at room temperature, and there is no evidence of concentration quenching for samples containing as many as 9 × 1020 Cr3+ ions/cm3. The intrinsic slope efficiency of LiCAF (67%) is close to that of alexandrite(65%). Recent flash-lamp-pumped Cr:LiCAF experiments demonstrated slope efficiencies of 1.6%, although passive losses in the laser rod of 3.5% cm−1 significantly affected the laser performance.

Spectrum



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Cr:LiCAF

PARAMETERS

Material and Specifications

Orientation	<2 deg (rod axis to crystal a-axis)
Parallelism	<10″
Perpendicularity	3′
Chamfer	0.1mm@45°
Surface Quality	10-5 S-D
Wavefront Distortion	λ/8 @632.8 nm
Surface Flatness	λ/10 @632.8 nm
Clear Aperture	>95%
Diameter Tolerance	+0/-0.2mm
Length Tolerance	±0.1mm
Coatings	R<1%@670nm+R<0.5% @700～1100nm on both faces
Laser Induced Damage Threshold	>15J/cm2 @TEM00, 10ns, 10Hz

Physical and Chemical Properties

Crystal Structure	Trigonal
Space Group	P31C
Lattice Constants	a=5.0116, c=9.9673 Å@2%Cr doping
Density (g/cm3)	2.988
Melting Point	766°C
Fracture Strength σf(MPa)	3.85±8(∥c)
Fracture Toughness KIC(MPa·m1/2)	0.39(∥a), 0.33(∥c)
Vickers Microhardness HV(GPa)	1.9±0.2(∥c)
Specific Heat (J/gK@298K)	0.935
Thermal Conductivity (W·m-1·K-1)	1.0(∥a), 1.68(∥c)
Thermal Expansion(10-6K-1)	22.2(∥a), -9.8(∥c)
Young's Modulus(GPa)	120(∥a), 85(∥c)
Typical Doping Level	0.8～1.5@.%

Optical characteristics

Absorption Peak Wavelength(nm)	640
Absorption Cross-section at Peak(10-20cm2)	3.0
Absorption Bandwidth at Peak Wavelength	～100nm
dn/dT (10-6K-1)	-4.2(no), -4.6(ne)
Refractive Index	n=1.41
Laser Wavelength(nm)	780
Energy-storage Lifetime(μs)	170
Emission Cross-Section (10-20cm2)	1.23@1.08mole%
Oscillator Strength(10-6)	48(4A2-4T2),39(4A2-4T1a), π
	28(4A2-4T2), 51(4A2-4T1a), σ
Nonlinear Refractive Index(m2/W)	4.5±0.7 @5% doping, 1064nm
Damage Threshold(J/cm2)	25@3%doping of Cr

APPLICATION

- Amenable to flashlamppumping
- Ultrashort pulse generation and amplification
- Large aperture laser rods
- Providing tunable high power laser radiation in the near IR
- Amplifications of stretched femtosecond pulses
- Laser rangefinders and illuminators, undersea optical communications, spectroscopy, and pumping other lasers

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