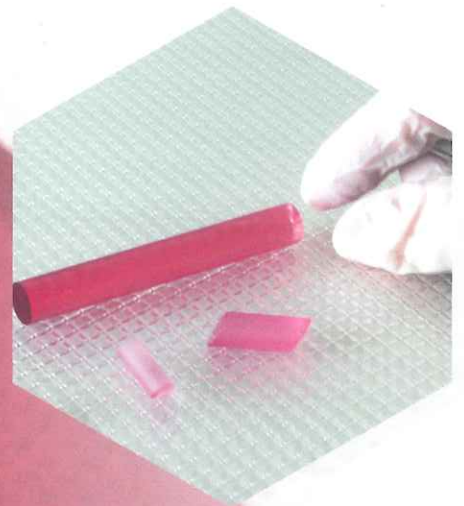


# The GT Crystal Systems Advantage

200 mm

World's largest Ti:Sapphire crystals



Our crystals are grown using the Heat Exchanger Method, (HEM). This unique method of growth allows for growth of the world's largest Ti:Sapphire crystals, with excellent optical properties. The growth of our crystals takes place in a reducing atmosphere in order to maximize  $Ti^{3+}$  ions, thereby reducing parasitic absorption and maximizing FOM values. The superior homogeneity and wave fronts of our laser rods allow laser systems to reach high energy levels without sacrificing beam profile quality.

## **Ti:Sapphire Applications**

Ti:Sapphire's thermal properties, wide emission range, (660 nm to 1180 nm), high-power capability and quality of beam profile are enabling a growing number of applications in the areas of radio therapy, proton therapy, accelerator physics, nuclear physics, infrared spectroscopy and materials characterization. Crystal Systems works closely with its customers to address the individual needs of their applications. This includes scaling-up the size of our crystals, increasing FOM values and providing more uniform crystalline structures to improve transmitted wave fronts.



# Manufacturing Laser Rods

We provide many design options; plano-ends, Brewster's angle ends, coated and other configurations. Our material ranges in size from 3 mm to 175 mm finished diameters. Absorption values range from 0.5 to 10+ /cm@ alpha 514 nm.

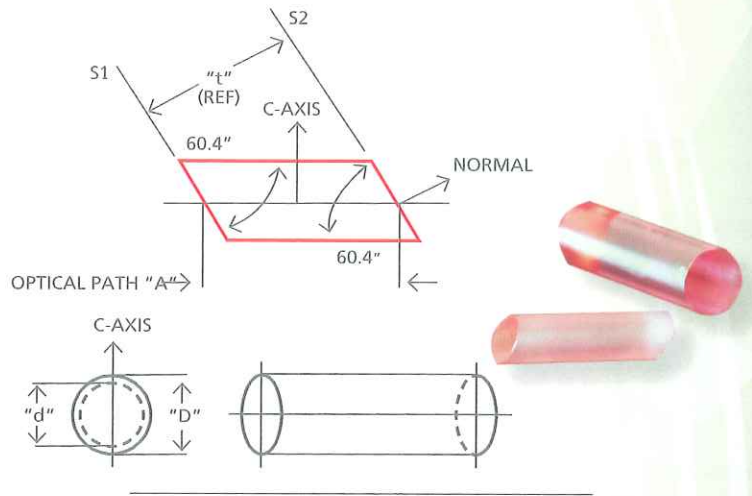
## Advanced polishing and coatings

We employ the most advanced polishing techniques in order to create ultra smooth surfaces with low sub-surface damage. Our coatings are engineered to provide maximum efficiency at peak power levels. By combining high quality material, the correct polishing techniques and optimized coatings, we provide the highest performance laser rods available.

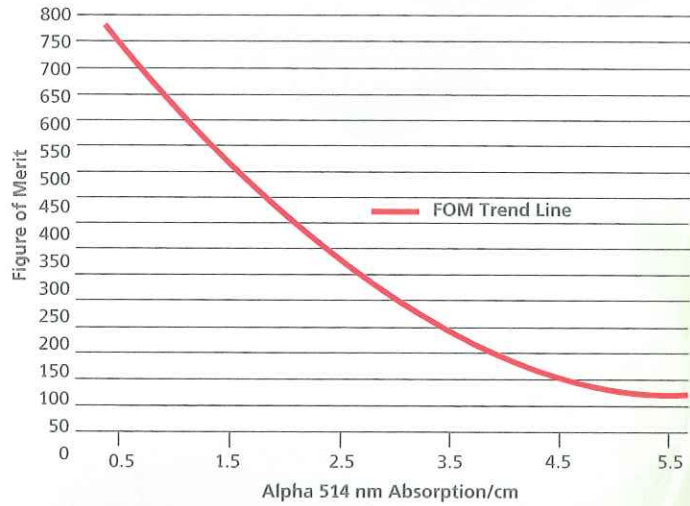
## Quality control at all stages of production

Every laser crystal we produce undergoes a multiple-stage, rigorous inspection process, using state-of-the-art test and measurement equipment. We test our rods for absorption values, homogeneity, light scatter, FOM, flatness, and transmitted wave fronts. Each HEM laser rod is examined and verified utilizing advanced interferometry equipment. This guarantees that the crystalline structure of the material meets the high homogeneity standards that today's laser technology platforms require. Figure of Merit, (FOM), is measured at 514 & 800 nm.

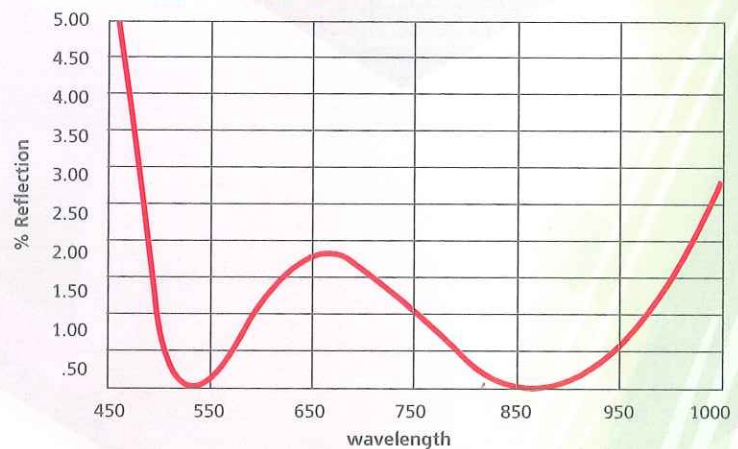
## Typical Brewster Cut Configuration



## FOM Versus Absorption Line



## Sapphire High-power Anti-reflection Coating



# Material Properties of HEM Ti:Sapphire

## Physical

Chemical Formula	Ti <sup>3+</sup> :Al <sub>2</sub> O <sub>3</sub>
Crystal Structure	Hexagonal System (Rhombohedral)
Unit Cell	a=4.758 Å, c=12.991 Å
Density	3.98 g/cm <sup>3</sup>
Hardness	9 mohs, 1525-2000 Knoop
Melting Point	2040°C (nominal)

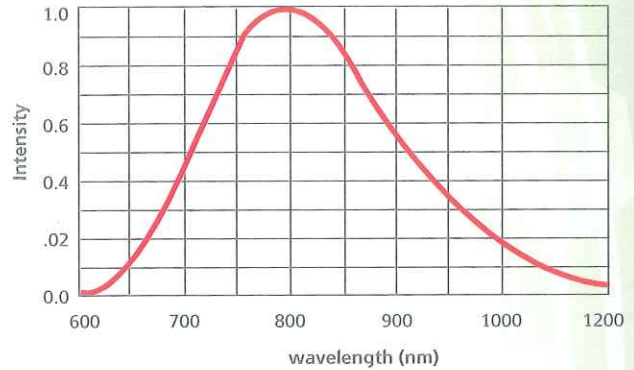
## Thermal

Thermal Conductivity	0.105 cal/cm-sec-°C
Thermal Expansion	8.40 X 10 <sup>-6</sup> per °C
Specific Heat	0.10 cal/g
Heat Capacity	18.6 cal/°C-mole @room temperature

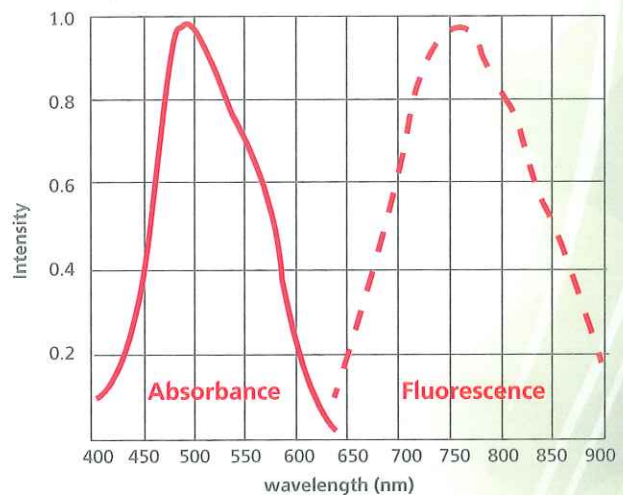
## Laser

Laser Action	4-Level Vibronic
Absorption Band	400-600 nm (peak at 490)
Tunable Range	660-1200 nm (peak at 800)
Fluorescence Lifetime	3.2 ms
Peak Cross-Section	3-4 x 10 <sup>-19</sup> cm <sup>2</sup>
Refractive Index	1.76 (nominal)

**Tunability Range of Ti:Sapphire**



**▯ Polarization**



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# Ti:Sapphire

For High Performance Lasers

High Figures  
of Merit (FOM)

No Bulk Scatter

Brewster's  
Angle and Plano  
Rods Available  
in Custom  
Configurations

Large Sizes and  
Highly Doped  
Material  
Available

High Laser  
Damage  
Threshold

**GT** ADVANCED  
TECHNOLOGIES