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POLYCRYSTALLINE CERAMIC YAG

Single crystal YAG, grown using the Czochralski method, has been widely used as the oscillator for solid state lasers. It requires long process time and high levels of experience to grow a YAG single crystal. Because of the pulled crystal method, the YAG single crystal has significant size and defect limitations such as core or facet defects that make single crystal YAG expensive.

Polycrystalline ceramic YAG is a more amenable product for mass production thus making it more cost efficient. Konoshima Chemical Industry perfected ceramic YAG over the past 15 years using in-house developed high purity raw materials and a unique sintering process. Ceramic YAG has comparable light scattering loss, larger rod size capabilities, unique composite structure designs, and superior doping profiles as compared to single crystal YAG making it a much more versatile product.

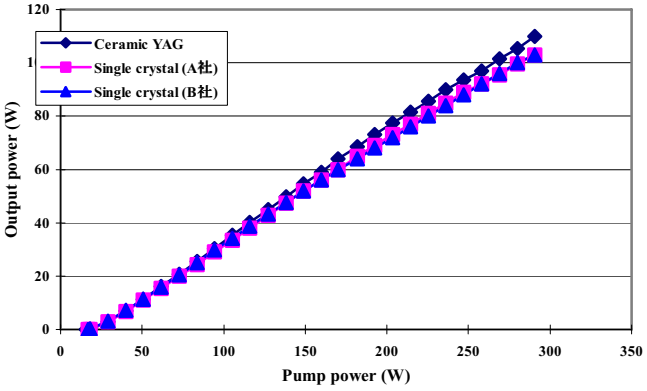
Konoshima ceramic YAG material has been merged with Baikowski fabrication techniques and is ready for distribution through its world wide sales network.

Advantages of Ceramic YAG

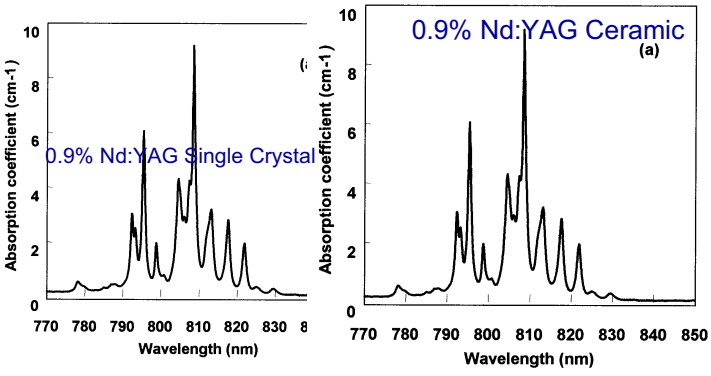
- Available size:
  Rod : ϕ 10mm × L 230mm
  Slab: W 60mm × T 10mm × L 230mm
  Plate: □ 100mm × T 20mm
- Homogeneity of dopant level (< 0.02%):
  Up to 4% Nd with no gradient
- Several dopants available:
  Nd^{3+}, Er^{3+}, Yb^{3+}, Cr^{4+}, Tm^{3+}
- Superior wavefront distortion (Non facet)
- Unique composite designs
  Different dopant levels or dopant elements
- Lower cost in mass production
- Other transparent ceramics are available on request

Comparison of efficiency

0.6% Nd:YAG ceramics vs single crystal lasers (T=10% coupler)



Comparison of Absorption Spectrum



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Laser Specifications

• Transmitted Wavefront	lambda/10 (per inch)
• Surface flatness	lambda/10 @ 632.8
• Clear Aperture	95%
• Surface Quality	10/5
• Parallelism	< 5 arc seconds
• Perpendicularity	< 1 min
• Chamfer	0.13 +/- 0.08 mm @ 45°
• Diameter Tolerance	+0/-0.05 mm (STD)
• Length Tolerance	+1/-0 mm (STD)

Configurations

- Mini rods for Diode pump
- Composites
- Flat / Parallel
- Tilt Ends
- Brewster / Brewster Ends
- Slabs
- Polished and Grooved Barrels
- Custom Geometries

Thin Film Coatings

- AR/AR @ 1064 nm, R < 0.25%
- Dichroics, HR 1064 nm > 99.8% R, HT 808 nm > 95.0% T
- Partially Reflective Designs
- Custom Designs Available

Standard Rods Dimensions

• Diameter	2.0 mm to 10 mm
• Length	1.0 mm to **230 mm**
• Slab	Miniature to **230 mm**
• Plate	Miniature to 100 mm

Physical Properties

• Nd Doping Level	**0 to 4% atomic**
• Chemical Formula	$Y_{3-X}Nd_XAl_5O_{12}$
• Crystal Structure	Cubic / Garnet
• Melting Point	1970°C
• Density	4.55 g/cm^3
• Hardness	5 times > to Single Crystal

Optical Properties

• Refractive Index	1.8169 @ 1064 nm
• Diode Pump Band	808.6 nm
• Fluorescence Lifetime	252 µs @ 0.6%
	234 µs @ 1.0%
	174 µs @ 2.0%
	96 µs @ 4.0%

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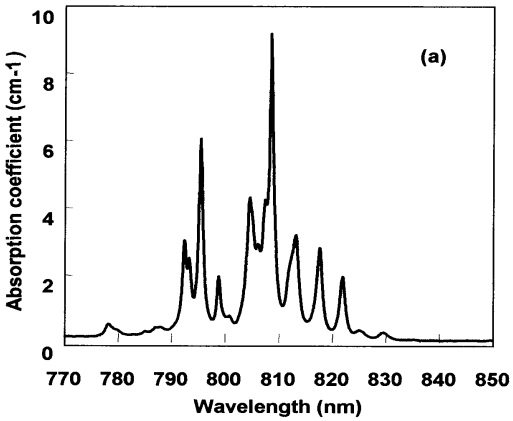
Thermal Conductivity

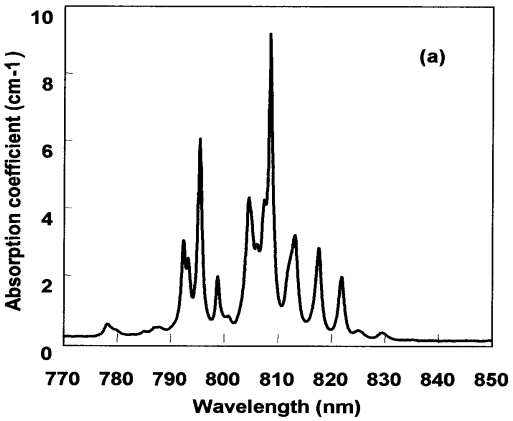
$K_{Single\ Crystal} = 10.5 \pm 0.5\ [WK^{-1}m^{-1}]$

$K_{Ceramics} = 10.7 \pm 0.5\ [WK^{-1}m^{-1}]$

Absorption Spectrum

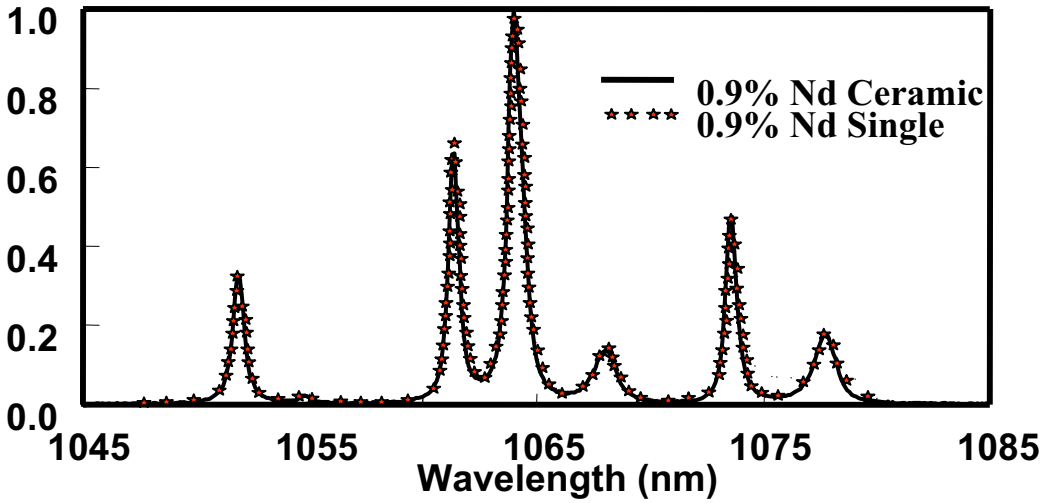


0.9% Nd:YAG single crystal



0.9% Nd:Ceramic YAG

Emission Spectrum



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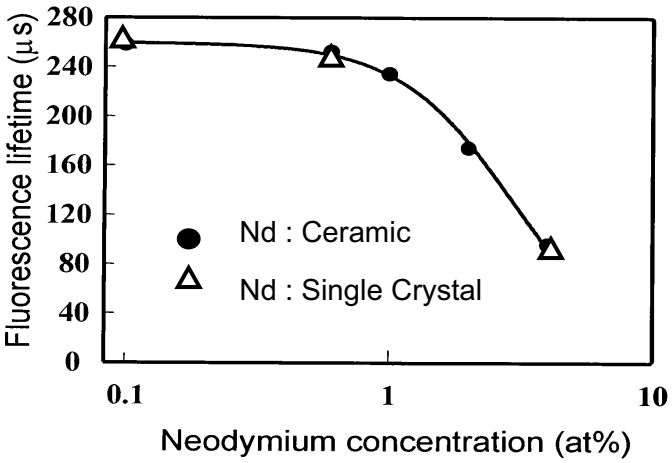
Fluorescence Lifetime



0.1% 258 μs
0.6% 252 μs
1.0% 234 μs
2.0% 174 μs
4.0% 96 μs

Absorption Spectrum

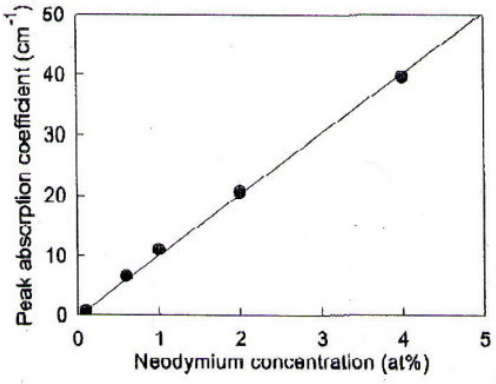


Fig. 2.6: Peak absorption coefficient of Nd:YAG ceramics around 808.6 nm as a function of neodymium concentration

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