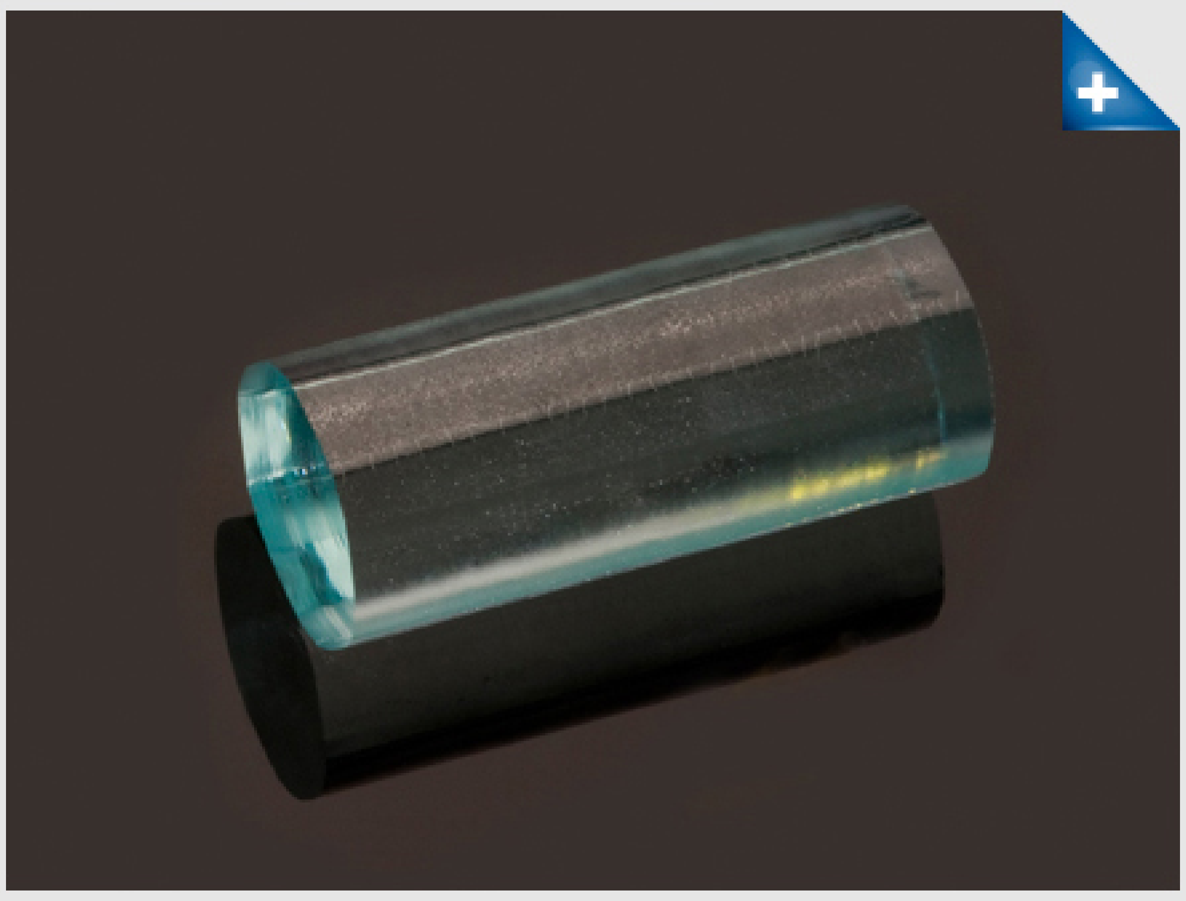
SCIENTIFIC MATERIALS CORP.
A FLIR Systems Company

Laser Materials $Lu_3Al_5O_{12}$



General Information

LuAG is of particular interest as a material for diode pumped solid-state lasers employing active ions such as Yb, Tm, Er, and Ho. This host has the smallest lattice constant of the rare earth garnets and the resulting crystal field in LuAG yields narrower linewidths and higher absorption and emission cross-sections. The net effect is higher efficiency laser devices.

Theoretical studies had previously predicted that LuAG should be a superior host for both Tm and Ho lasers.[2] Crystals to support these studies were grown by Scientific Materials Corporation under a NASA SBIR program. The experimental results for these materials showed that Tm, Ho, and codoped Tm:Ho LuAG systems were more efficient than comparable YAG and YLF systems.[2],[3] In fact, work has shown that Ho:LuAG has a slope efficiency of 82%, the highest reported.[3] Recent studies of Yb doped LuAG have also shown that it has a higher emission cross-section than YAG.[4] Lasing efficiency was lower, but is believed to be caused by impurities in the LuAG. Research is currently being performed to solve that problem.

In general, LuAG is a robust crystal with physical properties comparable to YAG. However, because Lu is denser than Y, the properties of the crystal do no change appreciably with the addition of dopant ions. For example, the thermal conductivity of 4% Tm:LuAG is about the same as 4% Tm:YAG even though the pure LuAG has a thermal conductivity only 60% that of YAG. The material is harder than YAG, has a higher melting point, and is believe to have a higher damage threshold.

Crystals of LuAG are available doped with Ho, Er, Tm, Tm:Ho, and Yb. Please call us with your specific requirement or for availability and pricing of currently stocked compositions and concentrations.

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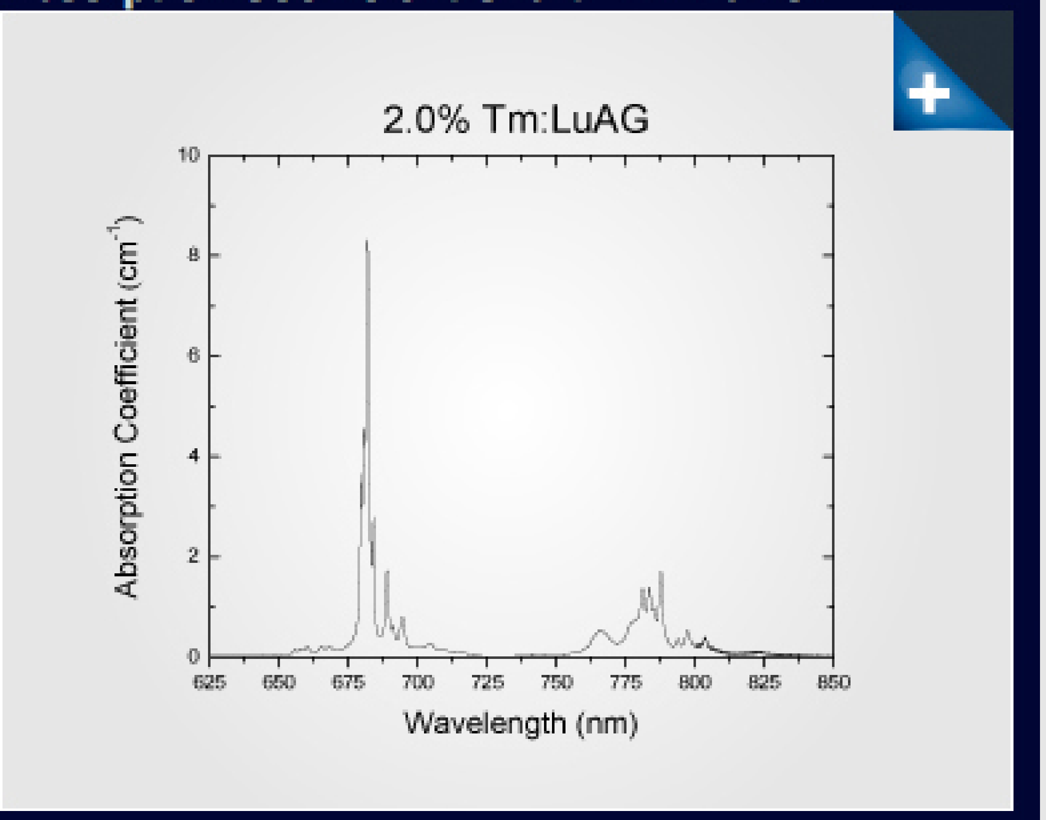
Dopant Ion

Dopant Ion Density @ 1 atomic %	
Y3+ Site	1.42×10^{20} cm^{-3}
Al3+Site (IV)	1.42×10^{20} cm^{-3}
Al3+Site (VI)	1.42×10^{20} cm^{-3}

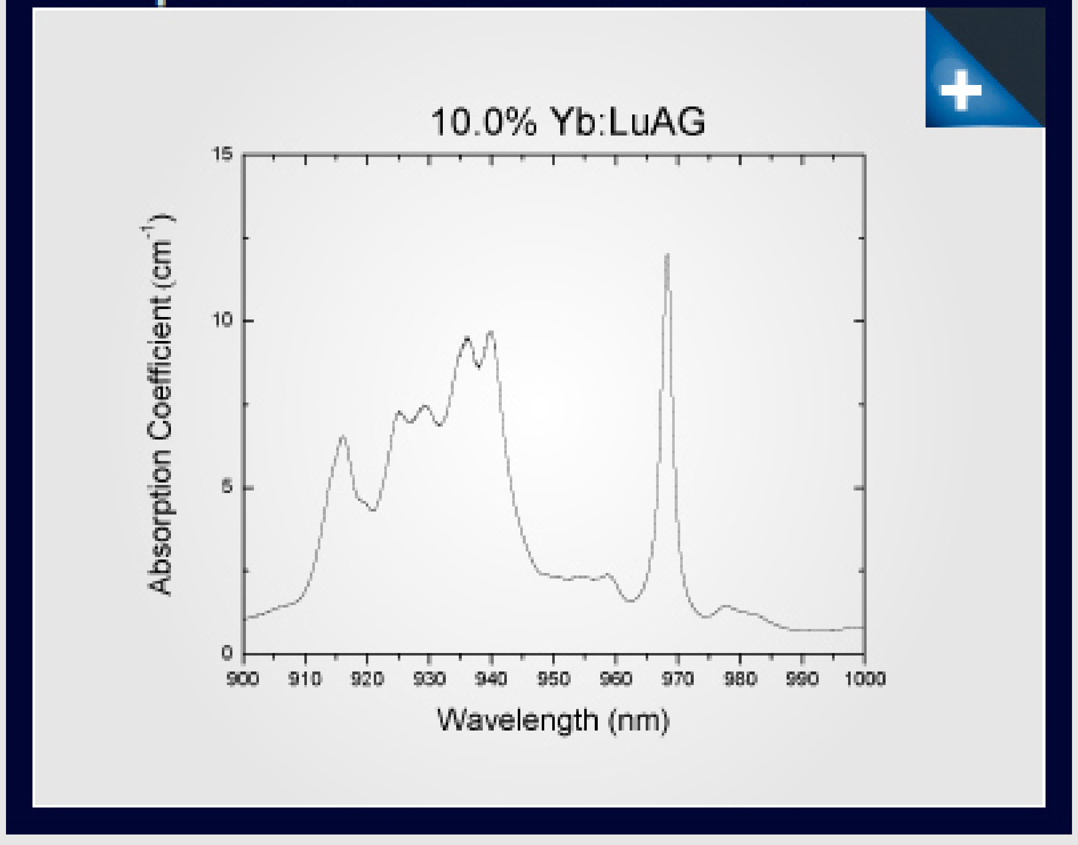
Physical Properties

Coefficient of Thermal Expansion [1]	6.13×10^{-6} K^{-1}
Thermal Diffusivity[1]	0.030 cm^2 s^{-2}
Thermal Conductivity [1]	8.3 W m^{-1} K^{-1}
Specific Heat (Cp) [1]	0.419 J g^{-1} K^{-1}
Refractive Index @ 632.8 nm	1.84
dn/dT (Thermal Coefficient of Refractive Index) @ 1064nm [1]	8.3×10^{-6} K^{-1} (a)
Molecular Weight	851.81 g mol^{-1}
Melting Point	1980°C
Density	6.71 g cm^{-3}
MOHS Hardness	8.4
Crystal Structure	Cubic
Standard Orientation	<111>
Y3+ Site Symmetry	D_2
Lattice Constant	a=11.91 Å/td>

Absorption Coefficient Chart: TM: LuAG



Absorption Coefficient Chart: YB: LuAG



References

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