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Laser Materials Y_2SiO_5

General Information

Yttrium Orthosilicate is a monoclinic biaxial crystal belonging to the C2/c ($C_{6\,2h}$) space group. Rare earth ions substitute for the Y^{3+} ions which occupy two crystallographic sites of C_1 symmetry. Emission and absorption spectra for rare earth dopants are polarized and generally have higher cross-sections when compared to YAG.

Crystals of Y_2SiO_5 are available with a variety of dopant ions including Ce, Pr, Nd, Eu, Tb, Ho, Er, Tm, Tm:Ho, and Cr.

Eu^{3+} and Er^{3+} activated YSO exhibit very narrow homogeneously broadened absorption line widths (sub kHz), embedded within a broader (~GHz) inhomogeneously broadened line, when cooled to cryogenic temperatures. Er^{3+}:YSO was shown to have a homogeneous optical resonance width of only 73 Hz, the narrowest atomic resonance observed in any solid state material[1].

Rare-earth activated YSO materials are of significant interest to applications including:

- Laser frequency stabilization[2]
- Quantum memory protocols[3]
- Optical signal processing[4]
- Laser Gain Media activated with Nd[5],[6],Tm[7], Er[9] and Yb[9] ions.

In general, Y_2SiO_5 is not as robust a material as YAG but is 10-20‰ stronger than YLF. It has a damage threshold of > 10 J/cm_2 for 10 ns pulses at 10 Hz which is comparable to that of YAG. The thermophysical properties of Y_2SiO_5 have been studied by researchers at Lawrence Livermore National Laboratory[8]. Because of its natural birefringence, Y_2SiO_5 does not exhibit thermally induced stress birefringence.

Note that SMC uses the coordinate axis naming convention described in[9], where b, D1 and D2 describe the 3 principle axis of polarization. Other references (3 for example) use an x, y, z coordinate system, corresponding to the b, D1 and D2 axis respectively.

Contact us with your specific requirements or for availability and pricing of currently stocked compositions and concentrations.

Physical Properties

Coefficient of Thermal Expansion [8]	7.4 x 10^{-6} YC^{-1} (a)
	7.4 x 10^{-6} YC^{-1} (b)
	5.2 x 10^{-6} YC^{-1} (c)
Thermal Diffusivity[8]	0.030 cm^2 s^{-2}
Thermal Conductivity [8]	4.49 W m^{-1} K^{-1} (a)
	4.60 W m^{-1} K^{-1} (b)
	4.08 W m^{-1} K^{-1} (c)
Specific Heat (Cp) [8]	0.646 J g^{-1} K^{-1}
Thermal Shock Resistant	
Refractive Index @ 632.8 nm	1.782(a)
	1.785(b)
	1.806(c)
Molecular Weight	2.85.9 g mol^{-1}
Melting Point	2070°C
Density	4.44 g cm^{-3}
Crystal Structure	Monoclinic
Standard Orientation	D1, D2, or b-axis
Y3+ Site Symmetry	Two Sites - C_1
Lattice Constant	a=14.411 Å
	a=6.726 Å
	a=10.419 Å
	β=122.2Y

References

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9) C. Li, Ch. Wyon, R. Moncorge, "Spectroscopic properties and Fluorescence Dynamics of Er3+ and Yb3+ in Y2SiO5", IEEE JQE 28, 1209 (1992).

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