

Cr⁴⁺: YAG - Passive Q-Switch

Passive Q-switches or saturable absorbers provide high power laser pulses without electro-optic Q-switches, thereby reducing the package size and eliminating a high voltage power supply. Cr⁴⁺:YAG is more robust than dyes or color centers and is the material of choice for 1 micron Nd lasers.

A small fraction of the chromium ions in YAG can be induced to change valence from the normal Cr³⁺ to Cr⁴⁺ with the addition of charge compensating impurities such as Mg²⁺ or Ca²⁺. The convenient measure of the Cr⁴⁺ concentration is the low power absorption coefficient α at 1064 nm. Typical α values vary from about 1.5 cm⁻¹ for tunable laser crystals to 3 - 6 cm⁻¹ for passive Q-switches. The actual Cr⁴⁺ ion density N in the crystal can be calculated from $N = \alpha / \frac{1}{2} \sigma_A$ where $\frac{1}{2} \sigma_A$ is the absorption cross-section with a value¹ of 5×10^{-18} cm².

Passive Q-switches are typically specified by the low power optical density (or %T) at the laser wavelength. Synoptics measures the α value in the Cr⁴⁺:YAG boule and adjusts the part thickness to the optical density specified. Thickness is a free parameter, but typically 1 - 5 mm.

Specifications

SYNOPTICS Standards	Orientation:	< 100 >
	Surfaces:	flat / flat
	Coatings:	AR < 0.2% at 1064 nm
	Damage Threshold:	> 500 MW / cm ²
Customer Values	Diameter:	typical: 5 - 10 mm
	Optical Density: at 1064 nm:	typical: 0.30, 0.40, 0.50, $\pm 10\%$

References

1. Review Article: A.G. Okhrimchuk and A.V. Shestakov, Optical Materials 3 (1994) pp.1-13.



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