

# Co<sup>2+</sup>:Spinel - Passive Q-Switch

---

Passive Q-switches or saturable absorbers generate high power laser pulses without the use of electro-optic Q-switches, thereby reducing the package size and eliminating a high voltage power supply. Co<sup>2+</sup>:Spinel (MgAl<sub>2</sub>O<sub>4</sub>) is the material of choice for the important eye-safe wavelengths near 1.5 microns. It has useful absorption that covers 1.2 to 1.6 micron laser transitions. Spinel is a hard, stable crystal that polishes well.

Cobalt substitutes readily for magnesium in the Spinel host without the need for additional charge compensation ions. A convenient measure of the Co<sup>2+</sup> concentration is the low power absorption coefficient  $\alpha$  at, for example, 1533nm, a typical wavelength for Erbium doped phosphate glass. SYNOPTICS grows crystals for passive Q-switches with  $\alpha$  values from about 0.5 to 3 cm<sup>-1</sup>. The actual Co<sup>2+</sup> ion density N in the crystal can be calculated from  $N = \alpha / \sigma_{GSA}$  where  $\sigma_{GSA}$  is the ground-state absorption cross-section with a value<sup>1</sup> of  $3.5 \times 10^{-19}$  cm<sup>2</sup>. This absorption is high enough to permit Q-switching of Erbium glass without intracavity focusing.

Passive Q-switches are typically specified by the low power Optical Density (or %T) at the laser wavelength. SYNOPTICS measures the  $\alpha$  value in the crystal and adjusts the part thickness to the optical density specified. Thickness is therefore a free parameter, but typically 1 - 5 mm.

---

***NORTHROP GRUMMAN***

**SYNOPTICS**

# Specifications

## SYNOPTICS Standard

Orientation: <111>  
Surfaces: flat / flat  
Coatings: AR < 0.25% at 1533nm  
Damage Threshold: > 500 MW / cm<sup>2</sup>

## Customer Values

Diameter: typical: 5 - 10 mm  
Optical Density: typical: 0.70, 0.80, 0.90 @ 1533nm

## References

1. K.V. Yumashev, Applied Optics **38**, No. 30 (1999) 6343-6346.

Specifications and information are subject to change without prior notice.  
© 2010 Northrop Grumman Corporation

---

1-704-588-2340 • FAX 704-588-2516  
1201 Continental Blvd., Charlotte, NC 28273  
email: [STSynoptics.Sales@ngc.com](mailto:STSynoptics.Sales@ngc.com)  
Website: [www.as.northropgrumman.com/synoptics](http://www.as.northropgrumman.com/synoptics)

***NORTHROP GRUMMAN***

SYNOPTICS