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RTP Crystal
Q Switch

DATA SHEET 742

Rubidium Titanyl Phosphate (RTP) single crystals are recently grown by Top Seeded Solution Growth (TSSG) from self-flux and treated electro-thermally. Present materials used for Pockels cells, KD*P and BBO have high damage thresholds of 250 Mw/cm^2 and $1Gw/cm^2$ at 1064nm. However both are hygroscopic and require hermetically sealed housings with protective windows. KD*P has high optical uniformity and is useful for large aperature applications. BBO has a high damage threshold and a low dielectric constant and is useful in high repetetion rate, high average power (up to 150W) diode pumped solid state lasers (DPSS lasers). Crystal Lithium Niobate (LN) has higher transmission, and high contrast ratio at average powers in the KW range. However, it has a low damage threshold ($10MW/cm^2$), piezoelectric ringing, and pyroelectric depolarization. Lithium Tantalate (LTA) does not exhibit piezoelectric ringing. However, its damage threshold ($20MW/ cm^2$) is still not sufficient for use with high peak power and high repetition rate used for Q switching in a thermally compensated mode.

The new crystal RTP is an isomorph of KTP. However, it has higher damage threshold (about 1.8 times KTP), higher resistivity, and no sign of electro-chromism. These are Biaxial crystals and natural Birefringence needs to be compensated by use of two crystal rods specially oriented so that beam passes along the X-direction. Input beam is polarized along the diagonal of the input face and Z and Y axis are perpendicular to the two side faces. Y and Z faces are rotated by 90° in the second crystal for thermal compensation.

The ‘o’ ray in the first crystal becomes the ‘e’ ray in the second crystal and vice versa, so that the thermal birefringence is compensated. Matched pairs (equal lengths polished together) are required for effective compensation.

The effective E-O constant r_{c1} (light propagating along the Y axis) is 23.6 pm/V and E-O constant r_{c2} (light propagating along the X axis) is 20.3 pm/V. The contrast ratio is better for r_{c2} constant. At repetition rates of 50KHz, the noise due to piezo-electric ringing is less than 3% while that in BBO it is 10% when operated at 30KHz. However in RTP Pockels cells, the half-wave voltage is about 40% and the hold-off is about 25% of that of BBO pockels cell.

Comparison Table

Crystal	Size	Half-wave V @ 1064nm	Contrast Ratio	Capacitance
RTP	$5 \times 5 \times 20mm^3$ (Total Length)	2265V	20dB	6pF
BBO	$5 \times 5 \times 20mm^3$ (Total Length)	5850V	40dB	< 2pF

These are transverse Pockels devices and the voltage increases linearly with wavelength for a given aspect ratio. BBO is slightly hygroscopic while RTP is not, so hermetical sealed housing is not required. Water cooled BBO Q switches are tested for average powers up to 150W, and RTP may be usable up to these levels at 1064nm. BBO optical bandwidth is 200nm to 2000nm while that of RTP is 400nm to 2500nm.