

# Inradoptics

## Pockels Cells (Q-Switches)



### Introduction

Electro-optic Pockels cells are used in applications that require fast switching of the polarization direction of a beam of light. These uses include Q-switching of laser cavities, coupling light into and out from regenerative amplifiers, and, when used in conjunction with a pair of polarizers, light intensity modulation. Pockels cells are characterized by fast response, since the Pockels Effect is largely an electronic effect that produces a linear change in refractive index when an electric field is applied, and they are much faster in response than devices based on acoustic changes in a material, for example. Although Inrad Optics Pockels cells can be used for phase modulation, during which sidebands are imprinted onto the frequency of the transmitted light at multiples of the drive frequency of the Pockels cell, these cells are not as efficient as devices that use an optimal crystal orientation and electric field direction and are designed specifically as phase modulators. Because of the desire for the light

beam to experience no birefringence in the absence of an electric field, the light beam propagates along the optic axis of a uniaxial crystal for all standard Inrad Optics Pockels cells.

### Crystal Types

Selection of the best crystalline material to use as the Pockels cell medium is determined by the wavelength of operation and the specific performance requirements such as damage threshold, average power handling ability, contrast ratio, extinction ratio, and repetition rate.

**KD\*P Pockels Cells** KD\*P is routinely used for Q-switching applications from the UV out to about 1.1  $\mu\text{m}$  where absorption limits its use in active cavities, although it can be useful at longer wavelengths when a few percent of absorption can be tolerated.

**BBO Pockels Cells** BBO can be useful at wavelengths from the UV out to about 2  $\mu\text{m}$ . The crystal handles high average powers better than either KD\*P or LiNbO<sub>3</sub>, although it has a relatively small electro-optic coefficient. Hence, for BBO Pockels cells, voltages typically are high. Longer crystals reduce the voltage requirement. Thinner crystals, for which the clear aperture is smaller, also require less voltage for a given application.

**LiNbO<sub>3</sub> Pockels Cells** LiNbO<sub>3</sub> is used at 1.064  $\mu\text{m}$  and longer wavelengths. As a Pockels cell with an electric field applied transverse to the direction of light propagation, it can be configured to operate at a lower voltage than KD\*P at 1.064  $\mu\text{m}$  by selecting the thickness and length of the crystal. LiNbO<sub>3</sub> is useful at infrared wavelengths as long as 4.0  $\mu\text{m}$  although the half wave voltage becomes quite high.

## KD\*P Pockels Cells

Model	Description	Aperture	Notes
PKC21-SG09	Single Crystal Pockels Cell, with AR coated windows, and sol-gel coated crystal.	9.5 mm	Windows are wedged, customer must select between net 0° or 1° wedge for the device
PKC21-SG12		12 mm	
PKC21-SG15		15 mm	
PKC21-SG20		20 mm	
PKC21-SG25		25 mm	
PKC26-SG09	Single Crystal Pockels Cell, with AR coated windows, and sol-gel coated crystal, in a compact package.	9 mm	Windows are wedged, net 0° wedge for the device
PKC02-SG09	Dual Crystal Pockels Cell, with AR coated windows, and sol-gel coated crystal.	9 mm	Windows are not wedged

Standard Wavelengths for KD\*P Pockels cells:

1064nm (Nd: YAG)  
 700-900nm (Ti:Sapphire, broadband)  
 755nm (Alexandrite)  
 694nm (Ruby)  
 532nm  
 355nm

Note: Custom wavelengths are available

## Inrad Optics Pockels Cells Specifications

Model	Crystal Type	Aperture (mm)	Wavelength Range (nm)	Transmission (%T) @ specific $\lambda$	Capacitance (pF)	Quarterwave Voltage @ 1064 nm	Extinction Ratio @ 1064 nm	Damage Threshold (MW/cm <sub>2</sub> )
PKC21	KD*P	9.5, 12, 15, 20, 25	.25 - 1.32 $\mu$ m	> 99 %	8, 9, 10, 14, 17	3.3 kV	> 1000:1 For $\leq$ 15mm aperture	> 800
PKC02		9	.25 - 1.32 $\mu$ m	> 96 %	14	1.65 kV	> 1000:1 For $\leq$ 15mm aperture	> 800
PKC26		.25 - 1.32 $\mu$ m	> 99 %	8	3.3 kV	> 1000:1	> 800	
PBCX1	BBO	2.5, 3.5	.22 - 2.1 $\mu$ m	> 98 %	3	3.6, 4.8 kV	> 1000:1	> 500
PBC05								
PBC06		3.5, 4.5, 5.5	.22 - 2.1 $\mu$ m	> 97 %	5	2.4, 3.1, 3.6 kV	> 500:1	> 500

Standard wavelengths for BBO Pockels cells:

1064nm (Nd:YAG)  
 532nm  
 355nm  
 266nm

Note: Custom wavelengths are available