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DATA SHEET 704

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SECOND HARMONIC GENERATION IN 90° PHASE MATCHED KDP ISOMORPHS

Dye lasers are versatile and efficient sources of tunable radiation for most of the visible spectrum. Conversion of this radiation to coherent tunable UV radiation has been obtained via second harmonic generation (SHG) in the non-linear crystals ADP and KDP. Over a small portion of the UV (from 257 - 275nm) ADP can be phase matched at 90° to the Z axis by temperature tuning. For this 90° orientation, a conversion efficiency of about 20% is obtained at an average incident power level of 100 watt (5cm long crystal, confocally focussed SHG of 532nm). For longer UV wavelengths, phase matching must be done by angle variation and conversion efficiency is typically reduced by a factor of ten to one hundred. If the incident light is not diffraction limited, even a larger efficiency reduction takes place.

Quantum Technology has collected data on the wavelengths that can be 90° phase matched in various KDP isomorphs. This data is shown in the form of a table on the reverse side. These crystals are uniaxial and negative (n_o is greater than n_e). Type I 90° phase matching requires that the fundamental beam should be polarized in the XY plane, and furthermore it should propagate in this plane at an angle of 45° to the XY axis. The generated second harmonic is then polarized along the Z axis. A crystal oven, the temperature of which was controlled by proportional temperature controller, was used to heat crystals above ambient; a thermoelectric cooler was used down to −20°C. For temperatures lower than this, a special cryostat was cooled by liquid nitrogen. Data was taken in 10°C steps over the range −20°C to +120°C. A laser-pumped dye laser provided the fundamental radiation. The three dyes used were crystal violet, rhodamine 6G, and sodium fluorescein.

All of the KDP isomorphs are water soluble and have a miximum safe operating temperature of 120°C (except RDP). The crystals are sensitive to thermal shock and should be heated slowly at a rate of less than about 5°C per minute. For other physical properties, refer to our data sheets 701 and 702.

Two other KDP isomorphs, CDA and D-CDA, 90° phase match the important 1060nm transitions to Nd:YAG and Nd:Glass. CDA phase matches 1064nm at 42°C and 1073nm at 61°C. D-CDA (99% deuterated) phase matches 1064nm at about 110°C depending upon the deuteration level. The damage threshold of the KDP isomorphs is quite high (about 200-300 MW/cm² peak powers), with somewhat higher values for the Arsenates than for the Phosphates. For CW lasers,the damage occurs around 20 watt for 10mm thickness. The damage is mostly due to the two photon absorption at the second harmonic radition. Therefore this value is true during the frequency doubling condition. During non-doubling condition, for example for ADP crystal, it is as high as 1500 MW/cm²

The KDP isomorphs are excellent harmonic generators for situations involving small peak powers or multimode power, where the higher conversion efficiency and the larger angular aperture of 90° phase matched crystals is required.

90° PHASE MATCHING TEMPERATURE AND WAVELENGTH

Material	Temperature	Wavelength nm	Material	Temperature	Wavelength nm
ADP	– 30°C	510	AD*A	– 15°C	578
	+ 30°C	525		+ 30°C	592
	+ 120°C	554		+ 120°C	625
AD*P	– 30°C	517	KDA	+ 20°C	598
	+ 30°C	532		+ 100°C	603
	+ 120°C	560			
			KD*A	+ 20°C	609
KDP	+ 20°C	518		+ 100°C	616
	+ 100°C	522			
			RDA	– 10°C	679
KD*P	– 30°C	528		+ 20°C	684
	+ 30°C	531		+ 100°C	695
	+ 120°C	538			
			RD*A	+ 20°C	695
RDP	+ 20°C	627		+ 100°C	717
	+ 80°C	635			
			CDA	+ 20°C	1050
ADA	– 30°C	568		+ 100°C	1078
	+ 30°C	586			
	+ 120°C	619	D-CDA	+ 20°C	1034
				+ 100°C	1062