International Tables for Crystallography (2013). Vol. D, Table 1.7.5.2, pp. 218–219.

Table 1.7.5.2. *Organic and organo-mineral crystals*

Abbreviations for crystals: 5-NU: 5-nitrouracil; MAP: methyl-(2,4-dinitrophenyl)-aminopropanoate; MNA: 2-methyl-4-nitroaniline; POM: 3-methyl-4-nitropyridine-*N*-oxide; NPP: *N*-(4-nitrophenyl)-L-propinol; 2A5NPDP: 2-amino-5-nitropyridine dihydrogen phosphate. OPA, OPO and SROPO are abbreviations for optical parametric amplification, oscillation and single resonant optical parametric oscillator, respectively. 1 e.s.u. = 4.19×10^{-4} m V^{-1}.

Crystal	Space group	Transparency	Refractive index phase matching (PM)	Damage threshold
Urea	$P\bar{4}2_1m$	220 nm to 2 µm	90° type-II PM at 597 nm PM to 238 nm	1.4 GW cm^{-2} at 354.7 nm
5-NU	$P2_12_12_1$	410 nm to 2 µm	$n_b > n_c > n_a$ Types I and II for SHG and SFG ($\omega + 2\omega \rightarrow 3\omega$)	
MAP	$P2_1$	500 nm to 2 µm	$n_x < n_y < n_z$ Non-critical PM: at 1.083 µm (along z); at 1.06 µm (between room temperature and liquid N_2)	>3 GW cm^{-2} at 1.06 µm, 10 ns, 10 Hz >150 MW cm^{-2} at 532 nm, 7 ns, 10 Hz
MNA	Cc	500 nm to 2 µm	$n_x = 2.093$ and $n_y = 2.494$ at 1.06 µm	
POM	$P2_12_12_1$	500 nm to 2 µm	$n_b > n_a > n_c$ Type-I PM tunable from 2 µm to 0.8 µm	~1 TW cm^{-2} at 610 nm (10 Hz, 100 fs) 2 GW cm^{-2} at 1.06 µm (20 ps) 150 MW cm^{-2} at 0.532 µm (20 ps) 50 MW cm^{-2} at 0.532 µm (10 ns)
NPP	$P2_1$	500 nm to 2 µm	$n_y > n_x > n_z$ $n_x - n_z = 0.78$ at 532 nm Non-critical PM at 1.15 µm $d\theta_{PM}/dT = -0.303$ mrad K^{-1}	10 GW cm^{-2} at 620 nm (100 fs, 10 Hz)
2A5NPDP	$Pna2_1$	0.420 to 1.7 µm	$n_x < n_y < n_z$ $n_z - n_x = 0.158$ at 546 nm $n_z - n_y = 0.152$ at 546 nm Type-II non-critical PM at 1.06 µm at 210 K Type-I ($d_{eff} = 2.25$ pm V^{-1}) PM at 1.34 µm Type-II ($d_{eff} = 4.5$ pm V^{-1}) PM at 1.34 µm $d\theta_{PM}/dT = -0.137$ mrad K^{-1} for type II at 1.34 µm $d\lambda/dT = 0.176$ nm K^{-1} for PM ($295 < T < 343$ K)	
DAST	Cc	700 nm to 2 µm	n_1(720 nm) = 2.519 n_2(720 nm) = 1.720 n_3(720 nm) = 1.635	
2A5NPCl	$P2_1$	410 nm to 1.65 µm	See Horiuchi *et al.* (2002)	

Crystal	Nonlinear coefficients SHG (d_{ij}) and EO (r_{ij})	OPO/OPA	References†
Urea	$d_{14} = 1.4$ pm V^{-1} $r_{41} = 56 \times 10^{-9}$ e.s.u. $r_{63} = 25 \times 10^{-9}$ e.s.u.	SRO $\lambda_p = 354.7$ nm $t_p = 7$ ns Yield: 20.5% Threshold: 45 mW Output: 6 mW at 1.22 µm Tunability: 0.499 to 1.23 µm	(*a*), (*b*), (*c*), (*d*)
5-NU	$d_{14} = d_{25} = d_{36} = 8.7$ pm V^{-1} at 1.06 µm		(*e*)
MAP	$d_{21} = 40 \pm 5 \times 10^{-9}$ e.s.u. $d_{22} = 44 \pm 5 \times 10^{-9}$ e.s.u. $d_{23} = 8.8 \pm 2 \times 10^{-9}$ e.s.u. $d_{25} = -1.3 \pm 2 \times 10^{-9}$ e.s.u.		(*f*)
MNA	$d_{11} = 250$ pm V^{-1} at 1.06 µm $d_{11} = 190$ pm V^{-1} at 1.2 µm $d_{11} = 165$ pm V^{-1} at 1.3 µm $d_{11} = 145$ pm V^{-1} at 1.47 µm $d_{11} = 125$ pm V^{-1} at 1.54 µm $(d_{11}^2/n^3)_{MNA} = 2000(d_{11}^2/n^3)_{LiNbO_3}$ $r_{11} = 67 \pm 25$ pm V^{-1} at 632.8 nm $\frac{1}{2}(n_1^3r_{11} - n_3^3r_{31}) = 270 \pm 50$ pm V^{-1}		(*g*), (*h*), (*i*)
POM	$d_{14} = d_{25} = d_{36} = 23 \pm 3$ pm V^{-1} at 1.06 µm $r_{41} = 3.6 \pm 0.6$ pm V^{-1} at 632.8 nm $r_{52} = 5.1 \pm 0.4$ pm V^{-1} at 632.8 nm $r_{63} = 2.6 \pm 0.3$ pm V^{-1} at 632.8 nm	OPA: $G = 10^3$ $\lambda_p = 532$ nm, 10 Hz, 25 ps $I_p = 130$ MW cm^{-2} Infrared input: 5 kW cm^{-2} at degeneracy	(*j*), (*k*), (*l*), (*m*), (*n*)
NPP	$d_{21} = 56.5 \pm 5$ pm V^{-1} at 1.34 µm $d_{22} = 18.7 \pm 2$ pm V^{-1} at 1.34 µm $d_{22} = 128$ pm V^{-1} at 1.06 µm $r_{12} = 25.5$ pm V^{-1} at 632.8 nm $r_{22} = 24$ pm V^{-1} at 632.8 nm $n^3r_{eff} = 60$ pm V^{-1} at 1.34 µm	OPA: G $\simeq 10^4$ at degeneracy (1.24 µm); pump: 620 nm, 100 fs, 10 Hz OPO, λ_{pump} tuning: $593 < \lambda_p < 670$ nm, $1000 < \lambda_{i,s} < 1500$ nm OPO, birefringence tuning: $\lambda_p = 670$ nm, $900 < \lambda_{i,s} < 1700$ nm DRO threshold at 670 nm: 0.45 MW cm^{-2}, pump: 2.3 MW cm^{-2} (60 ns, 10 Hz). Yield: 4.5%, IR_{output} 90 µJ	(*m*), (*o*), (*p*), (*q*), (*r*), (*s*)
2A5NPDP	At 1.34 µm: $d_{33} = 12 \pm 1$ pm V^{-1}, $d_{15} = 6 \pm 1$ pm V^{-1} At 1.06 µm: $d_{24} = 1 \pm 0.4$ pm V^{-1}, $d_{15} = 7 \pm 1$ pm V^{-1}	OPA: $\Gamma = 29 \pm 3$ cm^{-1} ($I_p = 30$ GW cm^{-2}); $d_{eff} = 2.6 \pm 0.5$ pm V^{-1}; $\lambda_s = 1.005$ µm, $\lambda_p = 612$ nm OPA: $\Gamma = 19 \pm 3$ cm^{-1}, $G = 10^6$, $\lambda_s = 1$ µm, $\lambda_i = 1.5$ µm, $\lambda_p = 612$ nm OPO: λ_{pump} tuning: $565 < \lambda_p < 590$ nm; $\lambda_s \simeq 1.003$ µm; $1286 < \lambda_i < 1500$ nm SRO: threshold: 6 MW cm^{-2}; $I_p = 37.2$ MW cm^{-2} (7 ns, 10 Hz); yield 3%, IR_{output} 150 µJ	(*r*), (*s*), (*t*), (*u*)

Table 1.7.5.2 (*cont.*)

Crystal	Nonlinear coefficients SHG (d_{ij}) and EO (r_{ij})	OPO/OPA	References†
DAST	d_{11}(1318 nm) = 1010 pm V^{-1} d_{11}(1542 nm) = 290 pm V^{-1} d_{26}(1542 nm) = 39 pm V^{-1} r_{11}(720 nm) = 92 pm V^{-1} r_{11}(1313 nm) = 53 pm V^{-1} r_{11}(1535 nm) = 47 pm V^{-1}	Terahertz generation (difference frequency mixing)	(*v*), (*w*)
2A5NPCl	$d_{11} = 9 \pm 4$ pm V^{-1} $d_{12} = 8 \pm 3$ pm V^{-1} $d_{13} = 11 \pm 4$ pm V^{-1} $d_{\rm eff}$ = 5.1 pm V^{-1} or 9.7 pm V^{-1}		(*x*)

† References: (*a*) Halbout *et al.*, 1979; (*b*) Morrell *et al.*, 1979; (*c*) Donaldson & Tang, 1984; (*d*) Rosker *et al.*, 1985; (*e*) Puccetti *et al.*, 1993; (*f*) Oudar & Hierle, 1977; (*g*) Levine *et al.*, 1979; (*h*) Lipscomb *et al.*, 1981; (*i*) Morita *et al.*, 1988; (*j*) Zyss *et al.*, 1981; (*k*) Sigelle & Hierle, 1981; (*l*) Zyss *et al.*, 1985; (*m*) Ledoux *et al.*, 1987; (*n*) Josse *et al.*, 1988; (*o*) Ledoux *et al.*, 1990; (*p*) Josse *et al.*, 1992; (*q*) Khodja *et al.*, 1995(*b*); (*r*) Khodja, 1995; (*s*) Zyss *et al.*, 1984; (*t*) Kotler *et al.*, 1992; (*u*) Fève *et al.*, 1999; (*v*) Bosshard, 2000; (*w*) Kawase *et al.*, 2000; (*x*) Horiuchi *et al.*, 2002.

conversion occur simultaneously inside the same crystal. An overview of these attractive materials is given in Brenier (2000).

1.7.6. Glossary

μ_0	vacuum magnetic permeability
ε_0	permittivity of free space
c	velocity of light in a vacuum
$\mathbf{P}$	electronic polarization
$\mathbf{P}_n$	nth order electronic polarization
$\mathbf{P}^{\rm NL}$	nonlinear polarization
$\chi^{(n)}$	nth order dielectric susceptibility tensor
ε	dielectric tensor
n	refractive index
n_x, n_y, n_z	principal refractive indices
(x, y, z)	principal axes of the index surface (optical frame)
n_o, n_e	refractive indices of the ordinary and extraordinary eigen modes
T	transmission coefficient
V	half of the angle between optic axes
ω	laser circular frequency
λ	laser wavelength
φ	laser phase
v_g	laser group velocity
$\mathbf{k}$	wavevector
$\mathbf{u}$	unit wavevector
(θ, φ)	spherical coordinates of the wavevector in the optical frame
Π	neutral vibration plane
$\mathbf{E}$	electric field vector
$(\mathbf{e}, E)$	unit vector and amplitude of the electric field
$\mathbf{D}$	dielectric displacement vector
$\mathbf{d}$	unit dielectric displacement vector
$\mathbf{H}$	magnetic field vector
$\mathbf{S}$	Poynting vector
$\mathbf{s}$	unit Poynting vector
W	work done per unit time
(X, Y, Z)	orthonormal wave frame where Z is along the wavevector
ρ	double refraction angle (walk-off angle)
∇	nabla operator
$\otimes$	tensorial product
$\cdot$	tensorial contraction
$\times$	vectorial product
Q^*	complex conjugate of Q
w_0	laser beam waist radius
Z_R	Rayleigh length of the laser beam
τ	laser pulse half duration
f	repetition rate of the pulsed laser
$P, P(t)$	laser instantaneous power
I	instantaneous laser intensity
$\tilde{E}$	total energy per laser pulse
$\tilde{P}$	average laser power
P_c	laser peak power
L	crystal length
$\chi_{\rm eff}, d_{\rm eff}$	effective coefficient
$\mathbf{F}^{(n)}$	nth order field tensor
Δk	phase mismatch
$\eta_{\rm SHG}$	conversion efficiency of second harmonic generation
G, h	spatial walk-off attenuation functions

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