International Tables for Crystallography (2013). Vol. D, Section 1.6.8, p. 179.

$$\Delta\eta_6 = p_{66}S_6 \sin(\omega t - k\xi) = p_{44}S_6 \sin(\omega t - k\xi) \quad (1.6.7.14)$$

since all other components are zero. This means that the original spherical indicatrix of the cubic crystal has been distorted to form a biaxial indicatrix whose axes oscillate in length according to

$$\begin{aligned} n_1 &= n_{\rm cub} + \frac{n_{\rm cub}^3}{2} p_{44}S_6 \sin(\omega t - k\xi) \\ n_2 &= n_{\rm cub} - \frac{n_{\rm cub}^3}{2} p_{44}S_6 \sin(\omega t - k\xi) \\ n_3 &= n_{\rm cub}, \end{aligned} \quad (1.6.7.15)$$

thus forming an optical grating of spatial periodicity given by the $k\xi$ term. In gallium arsenide, at a wavelength of light equal to 1.15 µm, $p_{11} = -0.165$, $p_{12} = -0.140$ and $p_{44} = -0.072$. It is convenient to define a figure of merit for acousto-optic materials (Yariv & Yeh, 1983) given by

$$M = \frac{n^6 p^2}{dv^3}, \quad (1.6.7.16)$$

where v is the velocity of the sound wave and d is the density of the solid. For gallium arsenide, d = 5340 kg m^{-3}, and for a sound wave propagating as above v = 5.15 m s^{-1}. At the wavelength λ = 1.15 µm, n = 3.37, and so it is found that M = 104. In practice, figures of merits can range from less than 0.001 up to as high as 4400 in the case of Te, and so the value for gallium arsenide makes it potentially useful as an acousto-optic material for infrared signals.

1.6.8. Glossary

α, β, γ	refractive indices of biaxial indicatrix, $\alpha < \beta < \gamma$
$\hat{\alpha}$	polarizability operator
B_i	ith component of magnetic induction
c	velocity of light
$c_{k\ell mn}$	$k\ell mn$th component of elastic stiffness tensor
$\chi_{ijk\ldots}$	$ijk\ldots$th component of generalized susceptibility
d	density
D_i	ith component of dielectric displacement
Δ	phase difference of light
$\hat{e}_{ijm}$	unit antisymmetric pseudotensor of rank 3
E_i	ith component of electric field
g_{ij}, G_{ij}	ijth component of gyration tensor
$\mathbf{G}$	gyration vector
$\gamma_{ij\ell}$	third-rank optical gyration susceptibility
$\mathbf{H}$	magnetic field intensity
η_{ij}	ijth component of dielectric impermeability tensor
ε_o	permittivity of free space
ε_{ij}	ijth component of dielectric tensor
κ	ellipticity of wave
$\mathbf{k}$	wavevector of light propagating in crystal ($\lvert k\rvert = 2\pi/\lambda$)
λ	wavelength of light
μ_o	vacuum magnetic permeability
n	refractive index of light
$n_\alpha, n_\beta, n_\gamma$	refractive indices for biaxial indicatrix, $n_\alpha < n_\beta < n_\gamma$
n_o	ordinary refractive index
n_e	extraordinary refractive index
Ψ_i	wavefunction of state i
P_i	ith component of electric polarization
$p_{ijk\ell}$	$ijk\ell$th component of elasto-optic (strain-optic) tensor
$\hat{p}$	electric dipole operator
ρ	optical rotatory power
$\pi_{ijk\ell}$	$ijk\ell$th component of linear piezo-optic tensor
r_{ijk}	ijkth component of linear electro-optic tensor
$\hat{s}$	unit vector in the direction of $\mathbf{s}$, the wave normal
S_{ij}	ijth component of strain tensor
T_{ij}	ijth component of stress tensor
v	velocity of sound
V	half the angle between optic axes
ω	cyclic frequency
x_i	direction of ith Cartesian axis, i = 1, 2, 3

References

Agranovich, V. M. & Ginzburg, V. C. (1984). *Crystal optics with spatial dispersion, and excitons*. Berlin: Springer.

Bloss, F. D. (1961). *An introduction to the methods of optical crystallography*. New York: Holt, Rinehart and Winston.

Born, M. (1933). *Dynamische Gittertheorie der Kristalle*. In *Handbuch der Physik*, **24**, 623–794.

Born, M. & Wolf, E. (1993). *Principles of optics*. Sixth corrected edition. Oxford: Pergamon Press. Reissued (1999) by Cambridge University Press.

Bragg, W. L. (1924). *The refractive indices of calcite and aragonite. Proc. R. Soc. London Ser. A*, **105**, 370.

Butcher, P. N. & Cotter, D. (1990). *The elements of nonlinear optics*. Cambridge University Press.

Devarajan, V. & Glazer, A. M. (1986). *Theory and computation of optical rotatory power in inorganic crystals. Acta Cryst.* A**42**, 560–569.

Ewald, P. P. (1916). *Zur Begründung der Kristalloptik. Ann. Phys. (Leipzig)*, **49**, 1–38, 117–143.

Glazer, A. M. (2002). *WINOPTACT: a computer program to calculate optical rotatory power and refractive indices from crystal structure data. J. Appl. Cryst.* **35**, 652.

Glazer, A. M., Lewis, J. G. & Kaminsky, W. (1996). *An automatic optical imaging system for birefringent media. Proc. R. Soc. London Ser. A*, **452**, 2751–2765.

Glazer, A. M. & Stadnicka, K. (1986). *On the origin of optical activity in crystal structures. J. Appl. Cryst.* **19**, 108–122.

Glazer, A. M. & Stadnicka, K. (1989). *On the use of the term 'absolute' in crystallography. Acta Cryst.* A**45**, 234–238.

Groth, P. (1906–1919). *Chemische Kristallographie*. Vols. I-V. Leipzig: Engelmann.

Hartshorne, N. H. & Stuart, A. (1970). *Crystals and the polarising microscope*. London: Arnold.

Jona, F. & Shirane, G. (1962). *Ferroelectric crystals*. Oxford: Pergamon.

Jones, R. C. (1948). *A new calculus for the treatment of optical systems. VII. Properties of N-matrices. J. Opt. Soc. Am.* **38**, 671–685.

Kaminow, I. P. (1974). *An introduction to electro-optic devices*. New York: Academic Press.

Kerr, P. F. (1959). *Optical mineralogy*. New York: McGraw-Hill.

Lines, M. E. & Glass, A. M. (1979). *Principles and applications of ferroelectrics and related materials*. Oxford: Clarendon.

Lowry, T. M. (1935). *Optical rotatory power*. London: Longmans.

Moxon, J. R. L. & Renshaw, A. R. (1990). *The simultaneous measurement of optical activity and circular dichroism in birefringent linearly dichroic crystal sections: I. Introduction and description of the method. J. Phys. Condens. Matter*, **2**, 6807–6836.

Moxon, J. R. L., Renshaw, A. R. & Tebbutt, I. J. (1991). *The simultaneous measurement of optical activity and circular dichroism in birefringent linearly dichroic crystal sections: II. Description of the apparatus and results for quartz, nickel sulphate hexahydrate and benzil. J. Phys. D Appl. Phys.* **24**, 1187–1192.

Narasimhamurty, T. S. (1981). *Photoelastic and electro-optic properties of crystals*. New York: Plenum.

Nussbaum, A. & Phillips, R. A. (1976). *Contemporary optics for scientists and engineers*. New Jersey: Prentice Hall.

Sapriel, J. (1976). *Acousto-optics*. Chichester: Wiley.

Szivessy, G. & Münster, C. (1934). *Über die Prüfung der Gitteroptik bei aktiven Kristallen. Ann. Phys. (Leipzig)*, **20**, 703–736.