Table 5 (*cont.*)

C_{12} S_{12} C_{12h}

4. $x \pm y$ phonon $\mathbf{q} = (1, \pm 1, 0)/\sqrt{2}$

$$\rho v^2 = (C_{11} - C_{12})/2$$

$$\mathbf{u} = (1, \pm 1, 0)/\sqrt{2} \quad (L)$$

$$\begin{vmatrix} \frac{1}{2}\varepsilon_0^2(P_{11}+P_{12}\pm 2P_{16}) & \pm\varepsilon_0^2 P_{66} & \cdot \\ \pm\varepsilon_0^2 P_{66} & \frac{1}{2}\varepsilon_0^2(P_{11}+P_{12}\mp 2P_{16}) & \cdot \\ \cdot & \cdot & 2\varepsilon_e^2 P_{31} \end{vmatrix}$$

$$\rho v^2 = C_{11}$$

$$\mathbf{u} = (1, \mp 1, 0)/\sqrt{2} \quad (T_1)$$

$$\varepsilon_0^2 \begin{vmatrix} P_{66} & -P_{16} & \cdot \\ -P_{16} & -P_{66} & \cdot \\ \cdot & \cdot & \cdot \end{vmatrix}$$

$$\rho v^2 = C_{44}$$

$$\mathbf{u} = (0, 0, 1) \quad (T_2)$$

$$\frac{\varepsilon_e\varepsilon_0}{\sqrt{2}} \begin{vmatrix} \cdot & \cdot & \mp P_{45}+P_{44} \\ \cdot & \cdot & \pm P_{44}+P_{45} \\ \mp P_{45}+P_{44} & \pm P_{44}+P_{45} & \cdot \end{vmatrix}$$

D_{12} C_{12v} D_{12h}

4. $x \pm y$ phonon $\mathbf{q} = (1, \pm 1, 0)/\sqrt{2}$

$$\rho v^2 = (C_{11} - C_{12})/2$$

$$\mathbf{u} = (1, \pm 1, 0)/\sqrt{2} \quad (L)$$

$$\begin{vmatrix} \frac{1}{2}\varepsilon_0^2(P_{11}+P_{12}) & \pm\varepsilon_0^2 P_{66} & \cdot \\ \pm\varepsilon_0^2 P_{66} & \frac{1}{2}\varepsilon_0^2(P_{11}+P_{12}) & \cdot \\ \cdot & \cdot & 2\varepsilon_e^2 P_{31} \end{vmatrix}$$

$$\rho v^2 = C_{11}$$

$$\mathbf{u} = (1, \mp 1, 0)/\sqrt{2} \quad (T_1)$$

$$\varepsilon_0^2 \begin{vmatrix} P_{66} & \cdot & \cdot \\ \cdot & -P_{66} & \cdot \\ \cdot & \cdot & \cdot \end{vmatrix}$$

$$\rho v^2 = C_{44}$$

$$\mathbf{u} = (0, 0, 1) \quad (T_2)$$

$$\frac{\varepsilon_e\varepsilon_0}{\sqrt{2}} \begin{vmatrix} \cdot & \cdot & P_{44} \\ \cdot & \cdot & \pm P_{44} \\ P_{44} & \pm P_{44} & \cdot \end{vmatrix}$$

Once the basis functions are available, with the use of the MTI, the electric susceptibility, elastic, piezoelectric, photoelastic and Raman tensors of dodecagonal point groups may be identified. They are tabulated in Tables 2-4.

The Christoffel matrices of the point groups with twelve-fold rotation axes may be calculated and the velocities of sound waves may be obtained by solving the secular equations (Auld, 1973). Based upon these results, the Brillouin tensors for dodecagonal point groups can be derived, following Cummius & Schoen (1972), to characterize the coupling between acoustic phonons and electric polarizability in quasicrystals. The results are presented in Table 5.

Discussion

The results given above can be extended to other tensors. For the point groups of C_{12}, C_{12h}, S_{12}, C_{12v}, D_{12} and D_{12h}, any one of the polar tensors of rank 2, such as the electric conductivity, strain and stress, has the same form as that given in Table 2. On the other hand, based upon the lists of Table 2 and Table 3, any one of the polar tensors of rank 3 or rank 4 can be easily determined by considering its intrinsic symmetry. Examples of such tensors are the linear electric-optic and the non-linear dielectric susceptibility and electrostriction tensors. We hope these results may be helpful to studies of the physical properties of quasicrystals.

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During the 14th European Crystallographic Meeting, to be held 2-7 August 1992 in Enschede, The Netherlands, the Oxford Cryosystems Award for the most outstanding presentation (oral or poster) in the use of low temperatures for crystallography or the design of equipment or techniques in low-temperature crystallography will be presented. An independent jury appointed by the Programme Committee of ECM-14 will judge candidate presentations. The prize (250 pound sterling) is donated by Oxford Cryosystems.

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