Answers to Examples Class 2: Stereographic Projections

Calcium Chloride

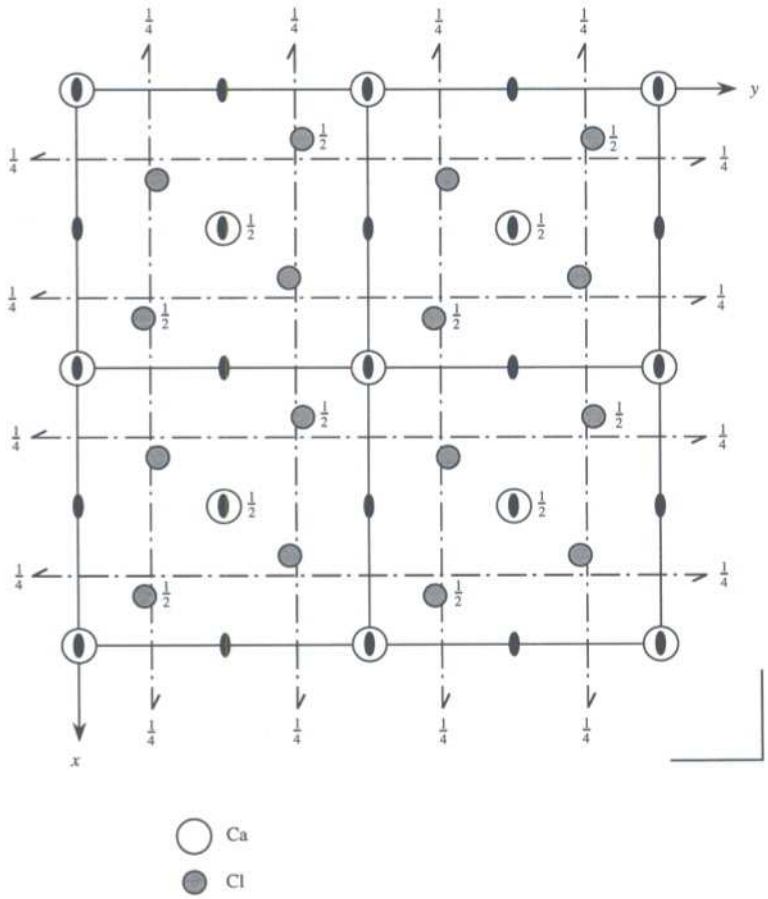


Figure 1: Structure projected along [001]. The Bravais lattice is P (the Ca at the origin has a different environment to that at the centre of the unit cell. Diads parallel to [001] go through each Ca and down the centres of the four sides of the cell containing [001]. (002) planes at $z = 0$ and $\frac{1}{2}$ are mirrors. (200) diagonal glide (n) planes cut at $x = \frac{1}{4}$ and $x = \frac{3}{4}$. (020) diagonal glide (n) planes cut at $y = \frac{1}{4}$ and $y = \frac{3}{4}$. 2_1 screw axes lie in the glide planes at heights $z = \frac{1}{4}$ and $z = \frac{3}{4}$ (only the former is illustrated).

Figure 2: Translational symmetry neglected in determining point group, which is mmm. Point symmetry of Ca is $2/m$ and that of Cl is m.

Calcite

$c/a = 0.854$, and $(0001) : (10\bar{1}1) = \tan^{-1} \frac{2c}{\sqrt{3}a} = 44.6°$. The $\{10\bar{1}1\}$ poles can be plotted using a Wulff net.

$(0001) : (01\bar{1}2) = \tan^{-1} \frac{c}{\sqrt{3}a} = 26.2°$

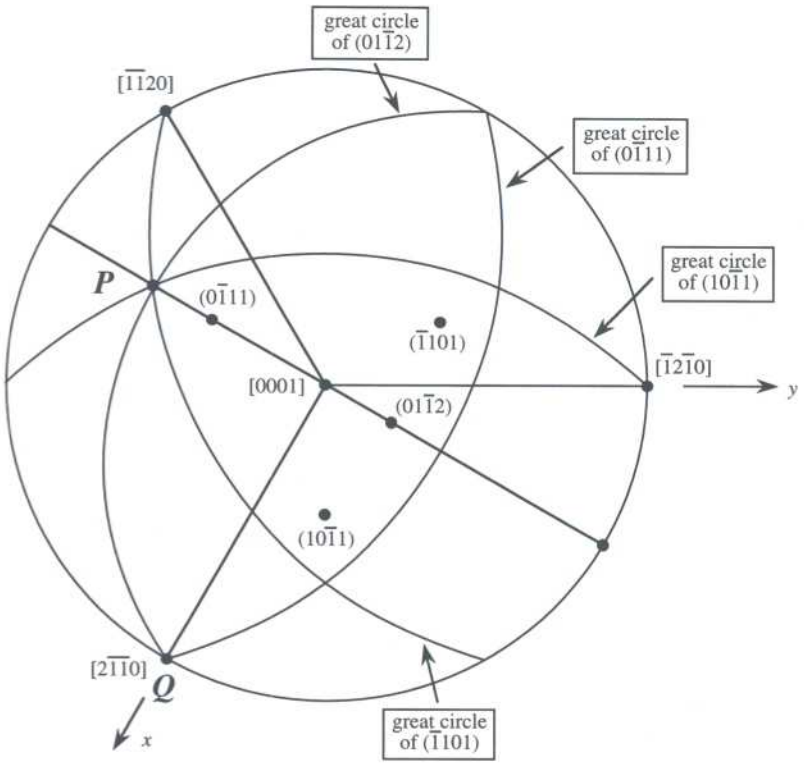
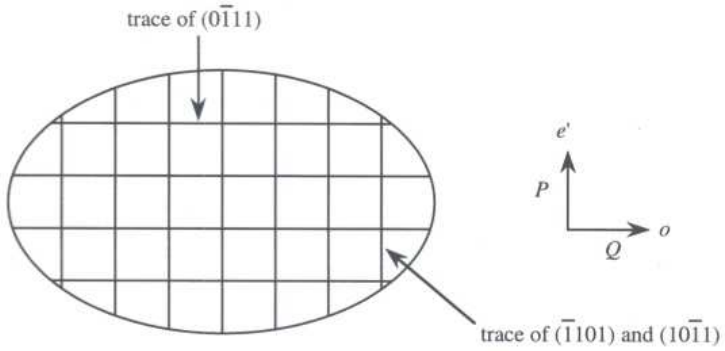


Figure 3: Required stereogram

Since calcite is trigonal ($\overline{3}m$), there are two poles in the northern hemisphere related to $(10\overline{1}1)$ by symmetry. From an inspection of Fig. 3, the trace of $(0\overline{1}11)$ on the plane $(01\overline{1}2)$ is Q. The traces of both $(10\overline{1}1)$ and $(\overline{1}101)$ are at P, which is 90° from Q.

When light is incident normally on $(01\overline{1}2)$, the vibration direction for the ordinary ray is in the plane $(01\overline{1}2)$ and normal to the unique triad axis, i.e. Q. The extraordinary ray will therefore have its vibration direction along P. P and Q are therefore the principal vibration directions.



$(01\overline{1}2)$ section of a thin crystal of calcite

Figure 4: Principal vibration directions and traces.

Coincidence Site Lattice

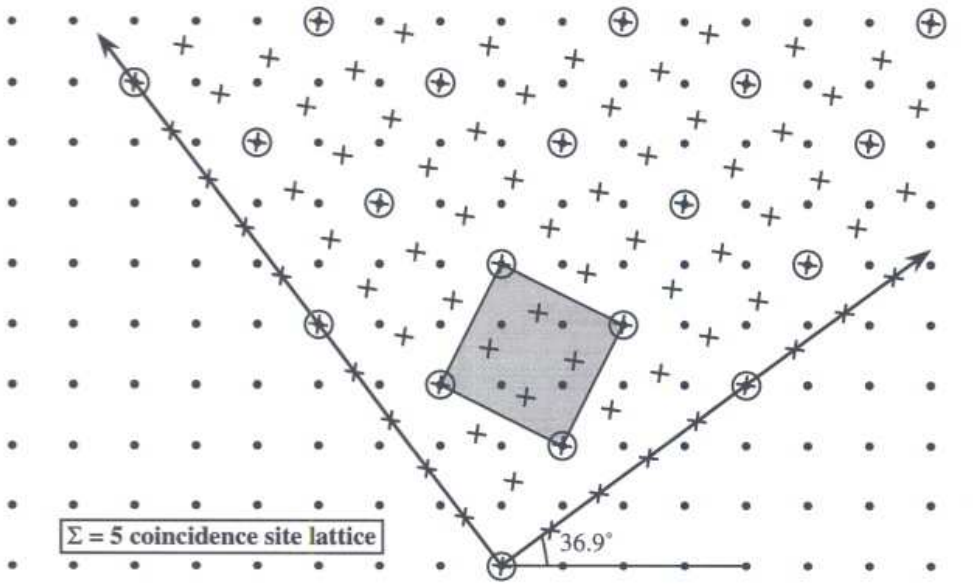


Figure 5: Referring to the lattice consisting of dots, and defining x to be horizontal pointing left, and y to be vertical pointing up, with z normal to the diagram, the basis vectors of the shaded CSL cell are [210], [$\overline{1}$20] and [001].

$$(\mathrm{Y\ J\ X}) = \frac{1}{5}\begin{pmatrix} 4 & \overline{3} & 0 \\ 3 & 4 & 0 \\ 0 & 0 & 5 \end{pmatrix} \tag{1}$$

Since the integer 5 is required to make all the elements of this matrix integral, $\Sigma = 5$.