Examples Class 1

Bragg Law

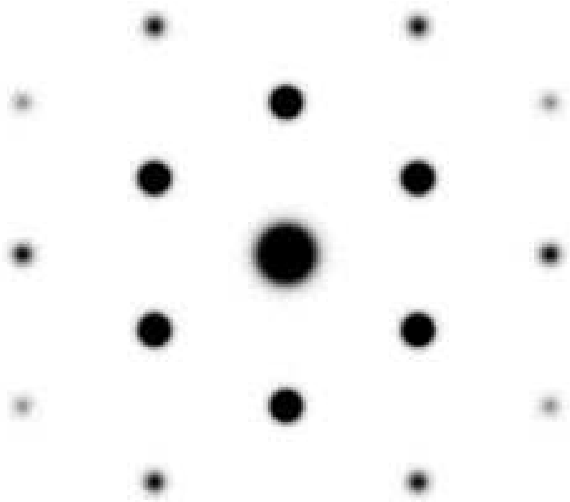
Show that the Bragg law $2d \sin\theta = \lambda$ can be expressed using reciprocal lattice vectors as

$$\mathbf{k}' - \mathbf{k} = \mathbf{g}$$

where $\mathbf{g}$ is a reciprocal lattice vector, $\mathbf{k}$ is a vector along the incident radiation of magnitude $1/\lambda$ and **k'** has the same magnitude but is oriented along the diffracted beam. λ is the wavelength of the radiation, θ is the Bragg angle and d is the spacing between adjacent planes in the crystal. Hence show that

$$2\mathbf{k}.\mathbf{g} = -g^2$$

What are the indices of diads, triads and tetrads in a cubic lattice? Find the two solutions for the following electron diffraction pattern which is from a metal with a cubic lattice.



Sketch Sterograms

The corners of a wooden cube are being cut off to make small equal faces of the form $\{111\}$. The first four new faces are cut in the order (a) (111); (b) $(11\bar{1})$; (c) $(\bar{1}11)$ and (d) $(\bar{1}1\bar{1})$.

1. Sketch stereographic projections, displaying the faces and the symmetry elements of the model before cutting, and after each new face is made.
2. Using the table of crystal systems in which defining symmetries are given for each crystal system, name the crystal system to which the model will belong after each cut

Table 1: The crystal systems

System	Conventional unit cell		Defining symmetry
Triclinic	$\mathbf{a_1} \neq \mathbf{a_2} \neq \mathbf{a_3}$	$\alpha \neq \beta \neq \gamma$	monad
Monoclinic	$\mathbf{a_1} \neq \mathbf{a_2} \neq \mathbf{a_3}$	$\alpha = \gamma, \quad \beta \geq 90°$	1 diad
Orthorhombic	$\mathbf{a_1} \neq \mathbf{a_2} \neq \mathbf{a_3}$	$\alpha = \beta = \gamma = 90°$	3 diads
Tetragonal	$\mathbf{a_1} = \mathbf{a_2} \neq \mathbf{a_3}$	$\alpha = \beta = \gamma = 90°$	1 tetrad
Trigonal	$\mathbf{a_1} = \mathbf{a_2} = \mathbf{a_3}$	$\alpha = \beta = \gamma \neq 90°$	1 triad
Hexagonal	$\mathbf{a_1} = \mathbf{a_2} \neq \mathbf{a_3}$	$\alpha = \beta = 90°, \gamma = 120°$	1 hexad
Cubic	$\mathbf{a_1} = \mathbf{a_2} = \mathbf{a_3}$	$\alpha = \beta = \gamma = 90°$	4 triads