Miller Indices

Introduction:

Crystals are made up of large no of parallel - equidistant planes, passing through the lattice points called lattice planes.

The 1er distance b/w any two adjacent plane is called Interplanar distance (d).

Definition:

Miller indices are the 3 smallest possible integers which have the same ratio as the reciprocals of the Intercepts of the plane concerned along the 3 axes.

Procedure:

1. Find the intercepts along the 3 axis
2. Find the coefficient of the Intercepts i.e 3, 6, 2
3. Find the reciprocal of these no $\frac{1}{3}, \frac{1}{6}, \frac{1}{2}$
4. Convert these reciprocal to whole no by (x) by reciprocal with their LCM

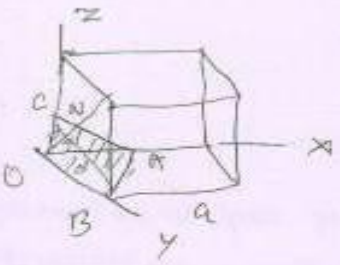
   $6 \times \frac{1}{3}, 6 \times \frac{1}{6}, 6 \times \frac{1}{2} \Rightarrow 2\ 1\ 3$
5. enclose these no in bracket ( ).

Points to ponder:

1) It should be enclosed in bracket → ( )
2) There should not be any comma in b/w the nos
3) IF the plane (213) means it should be read as two one three & not as two hundred thirteen

d spacing in cubic lattice

d spacing is the distance b/w any two successive plane



Consider a cubic crystal with a as length of the cube edge & a plane ABC as shown in figure. This plane belong to a family of planes whose miller indices (h k l)

The l^er ON from the origin of the cube to the plane ABC represents interplanar spacing (d) of this family.

OA along OX = α'
OB along OY = β'
OC along OZ = γ'

$OA : OB : OC = \frac{1}{h} : \frac{1}{k} : \frac{1}{l}$

$= \frac{a}{h} \cdot \frac{a}{k} \cdot \frac{a}{l}$

$\cos\alpha' = \frac{ON}{OA} \div \frac{a}{a/h} = \frac{dh}{a}$

$\cos\beta' = \frac{ON}{OB} = \frac{d}{a/k} = \frac{dk}{a}$

$\cos\gamma' = \frac{ON}{OC} = \frac{d}{a/l} = \frac{dl}{a}$

$\cos^2\alpha' + \cos^2\beta' + \cos^2\gamma' = 1$

$\left(\frac{dh}{a}\right)^2 + \left(\frac{dk}{a}\right)^2 + \left(\frac{dl}{a}\right)^2 = 1$

$\frac{d^2}{a^2}(h^2+k^2+l^2) = 1$

$d^2 = \frac{a^2}{h^2+k^2+l^2}$

$d = \frac{a}{\sqrt{h^2+k^2+l^2}}$