Question

A compound is formed by two elements X and Y. Atoms of the element (Y) make ccp and those of the element (X) occupy all the octahedral voids. What is the formula of the compound?

Answer:

For ccp or fcc lattice unit cell

Number of atoms at lattice points per unit cell = (Number of corners x contribution of atom at corner towards unit cell) + (Number of face centres x contribution of atom at face centre towards unit cell)

$= 8 \times \frac{1}{8} + 6 \times \frac{1}{2} = 4$

Thus there are 4 Y atoms per unit cell.

Number of octahedral voids = Octahedral voids at body centre + (Octahedral voids at edge centre x contribution of void at edge centre towards unit cell)

$= 1 + 12 \times \frac{1}{4} = 4$

Ratio of X and Y atoms per unit cell is 4:4 or 1:1

Hence formula of the compound is XY.

Question

Atoms of element B form hcp lattice and those of element A occupy $\frac{2}{3}$rd of tetrahedral voids. What is the formula of the compound formed by the elements A and B.

Answer:

For hcp lattice unit cell:

Number of tetrahedral voids = 2x Number of atoms in unit cell

'A' occupy $\frac{2}{3}$rd of tetrahedral voids and B occupy hcp lattice points.

Thus, number of 'A' per unit cell = $\frac{2}{3}$ x (Number of tetrahedral voids)

$= \frac{2}{3} \times (2 \times \text{Number of 'B' atoms})$

$= \frac{4}{3} \times \text{Number of B atoms}$

Thus formula of the compound is $A_{\frac{4}{3}}B$ or A_4B_3

Question

A compound is formed by two elements M and N. The element N forms ccp and atoms of M occupy $\frac{1}{3}$rd of tetrahedral voids. What is the formula of the compound?

Answer:

Number of N atoms per unit cell = Number of atoms per unit cell for ccp lattice = 4

Number of M atoms per unit cell = $\frac{1}{3}$ x Number of tetrahedral voids

$= \frac{1}{3} \times (2 \times \text{Number of ccp lattice points per unit cell})$

$= \frac{1}{3} \times (2 \times 4)$

$= 8/3$

Thus formula of compound is $M_{8/3}N_4$ or M_2N_3

Question

A cubic solid is made of two elements P and Q. Atoms of Q are at the corners of the cube and P at the body-centre. What is the formula of the compound? What

are the coordination numbers of P and Q?

Answer:

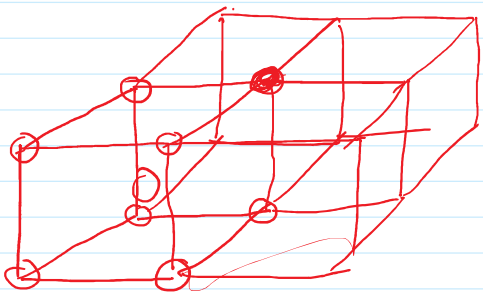
i) Number of Q atoms per unit cell = Number of corners per unit cell x contribution by corner atoms towards unit cell

$= 8 \times \frac{1}{8} = 1$

Number of P atoms per unit cell = Number of body centres per unit cell x Contribution by body centre atoms towards unit cell = $1 \times 1 = 1$

Hence formula of compound is PQ

ii) Atom at body centre is surrounded by 8 corner atoms and atom at corner is surrounded by 8 body centre atoms. Thus coordination number of P and Q both is 8.



Question

Ferric oxide crystallises in a hexagonal close-packed array of oxide ions with two out of every three octahedral holes occupied by ferric ions. Derive the formula of ferric oxide.

$F_{\frac{2}{3}}O$

Answer:

For hcp lattice unit cell:

Number of octahedral voids = Number of atoms in unit cell

Fe ions occupy $\frac{2}{3}^{rd}$ of octahedral voids and 'O' ions occupy hcp lattice points.

Thus, number of 'Fe ions' per unit cell = $\frac{2}{3}$ x number of octahedral voids

$= \frac{2}{3} \times$ number of hcp lattice points

$= \frac{2}{3} \times$ number of O ions

Thus formula of compound is $Fe_{\frac{2}{3}}O$ or Fe_2O_3