VI\_8: **Diamond structure:**

 The diamond structure is a combination of two inter-penetrating face-centered-cubic sub-lattices. One sub-lattice has its origin at the point (0, 0, 0), and the other at a point one quarter of the way along the body diagonal (at the point a/4, a/4, a/4). The projection of atoms in the cubic cell of diamond cubic structure is shown in fig-1.

 Since each atom has only four nearest neighbors, its co-ordination number is 4, and thus the diamond cubic structure is loosely packed.

 There are eight corner atoms along with six face-centered atoms and four more atoms are presented in the unit cell. Again, each face-centered atom is shared by two unit cells and the corner atom is shared

  

by eight adjacent unit cells. Hence, the number of atoms per unit cell

 = ( $\frac{1}{2}$ x 6) + ($\frac{1}{8}$ x 8 ) + 4 = 8.

 If ‘a’ be the cube edge,

 AC2 = a2 + a2 = 2 a2

 AD2 = AC2 + CD2 = 2 a2  + a2 = 3 a2

 Or, AD ( Body diagonal) = $\sqrt{3}$ a.

 There are three full spheres and two half spheres along the diagonal. If ‘r’ is the radius of the spherical atom,

 AD = r + 3(2r) + r = 8r

 Or, 8r = $\sqrt{3}$ a.

 Or, a = $\frac{8r}{√3}$

 Volume of the unit cell V = a3 = ($\frac{8r}{√3}$ )3

Volume of all atoms in the unit cell ѵ = 8 x $\frac{4}{3}$ $π$r3

So, packing fraction = $\frac{ѵ}{V}$ = (32 $π$r3/3)/( 8r/$\sqrt{3}$)3

 

 = 0.34

 Or, PF = 34%

 Thus, the structure is loosely packed. The unit cell of diamond is similar to that of germanium and silicon.





