Covalent Solids

Thapar Institute of Engineering & Technology
(Deemed to be University)
Bhadson Road, Patiala, Punjab, Pin-147004
Contact No. : +91-175-2393201
Email : info@thapar.edu

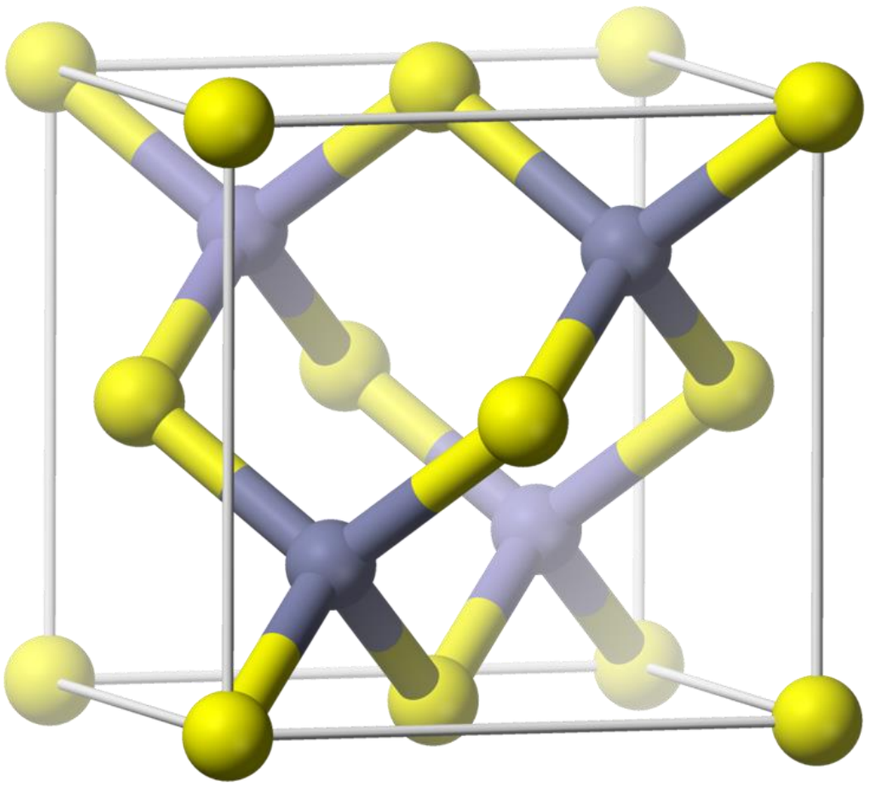
THAPAR INSTITUTE
OF ENGINEERING & TECHNOLOGY
(Deemed to be University)

Covalent solids

1. Made up of covalent bonded materials.
2. Covalent bond is directional and strong bond.

Covalent solids

Diamond cubic structure



•Orbital hybridization of C atoms (sp^3) requires that the atoms are tetrahedrally coordinated and thus the structure has high degree of directionality.

•One unit-cell consists of two **FCC lattices**, one at (0 0 0) and another at (¼ ¼ ¼).

•Only 50% of the tetrahedral voids are occupied.

•In case of compounds, FCC lattice can be formed by one type of atom and remaining atoms, usually from the same group, occupy half of the tetrahedral sites.

•Examples: Si, Ge, GaAs

Packing fraction of Diamond cubic structure

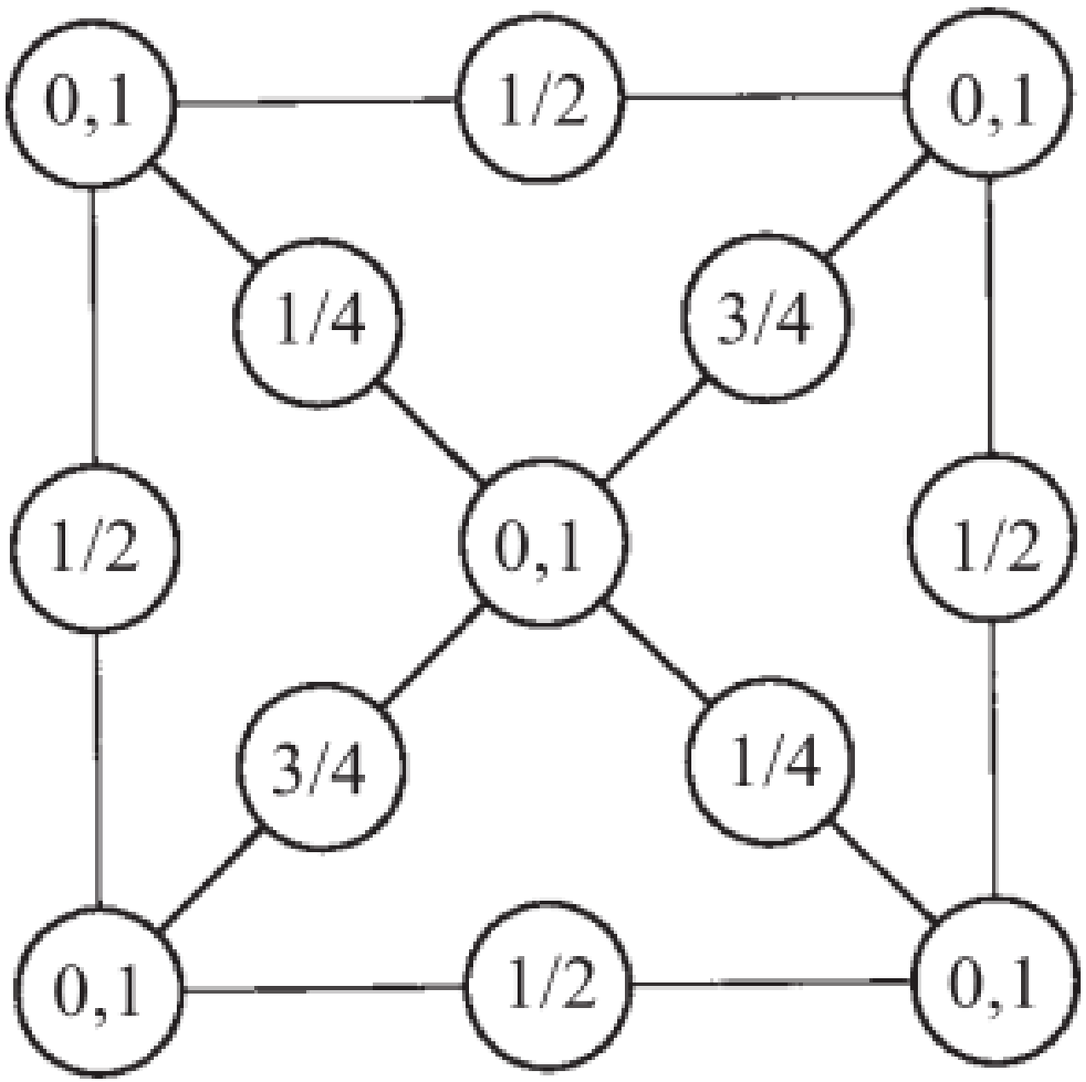
$$\text{APF} = \frac{\text{No of atoms in a unit cell} \times \text{Volume of one atom}}{\text{Volume of the unit cell}}$$

The relation between a and r is : ¼ x a√3 = 2 r

No. of atoms in a diamond cubic unit cell: 8

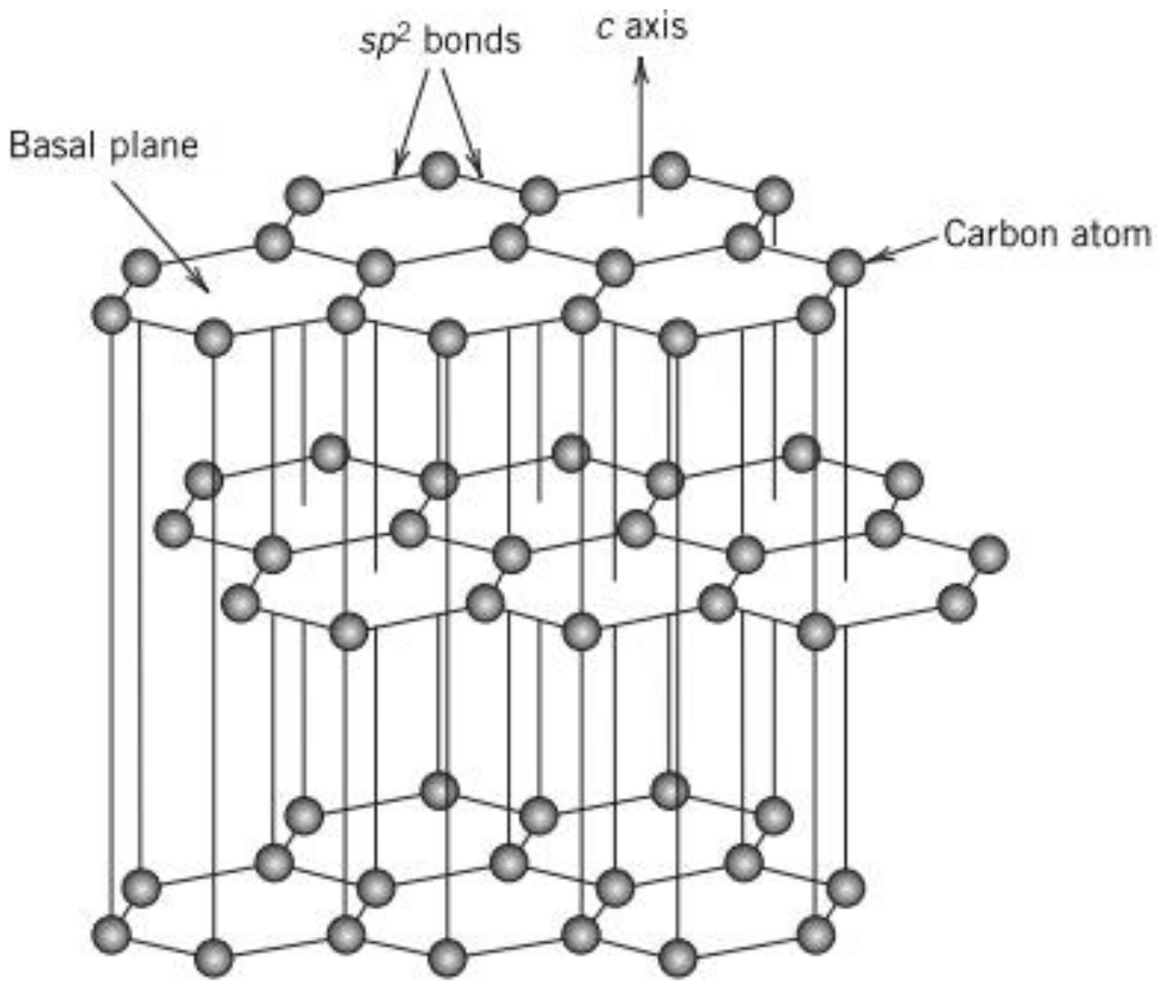
Therefore, APF = 34%

Plan view in Diamond cubic



Covalent solids

Graphite structure



- Graphite has a layered structure where in each layer, carbon atoms are sp^2 hybridized and they make a hexagonal pattern.

- However, the bonding between individual layers is Van der Walls type of bonding. That is why Graphite is a soft material and is used as a lubricant.

Summary

1. Covalent solids have strong directional nature.
2. Diamond have sp^3 hybridization while graphite has sp^2 hybridization.
3. Only 50% of the voids in the diamond cubic structure are occupied.
4. The diamond cubic structure has packing fraction of only 34%.
5. Graphite has weak Vander Waal bond between two layers.