



# Covalent Solids

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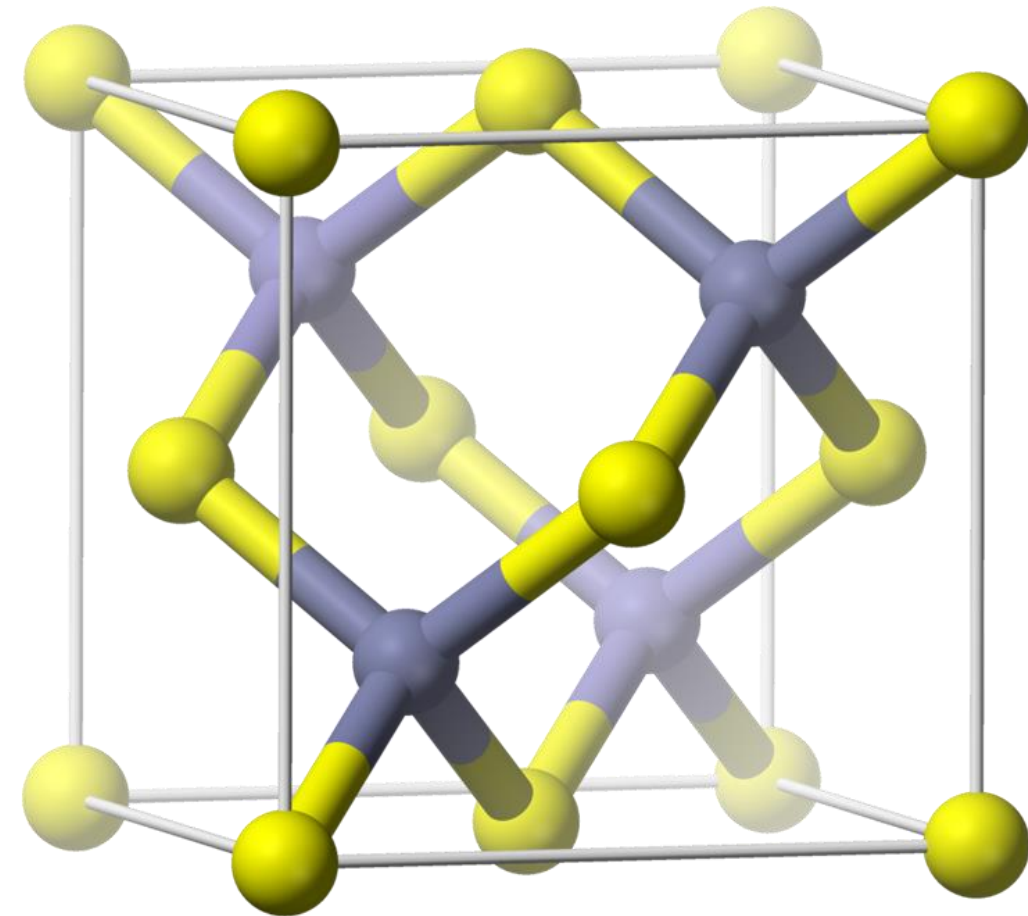


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1. Made up of covalent bonded materials.
2. Covalent bond is directional and strong bond.

## Diamond cubic structure



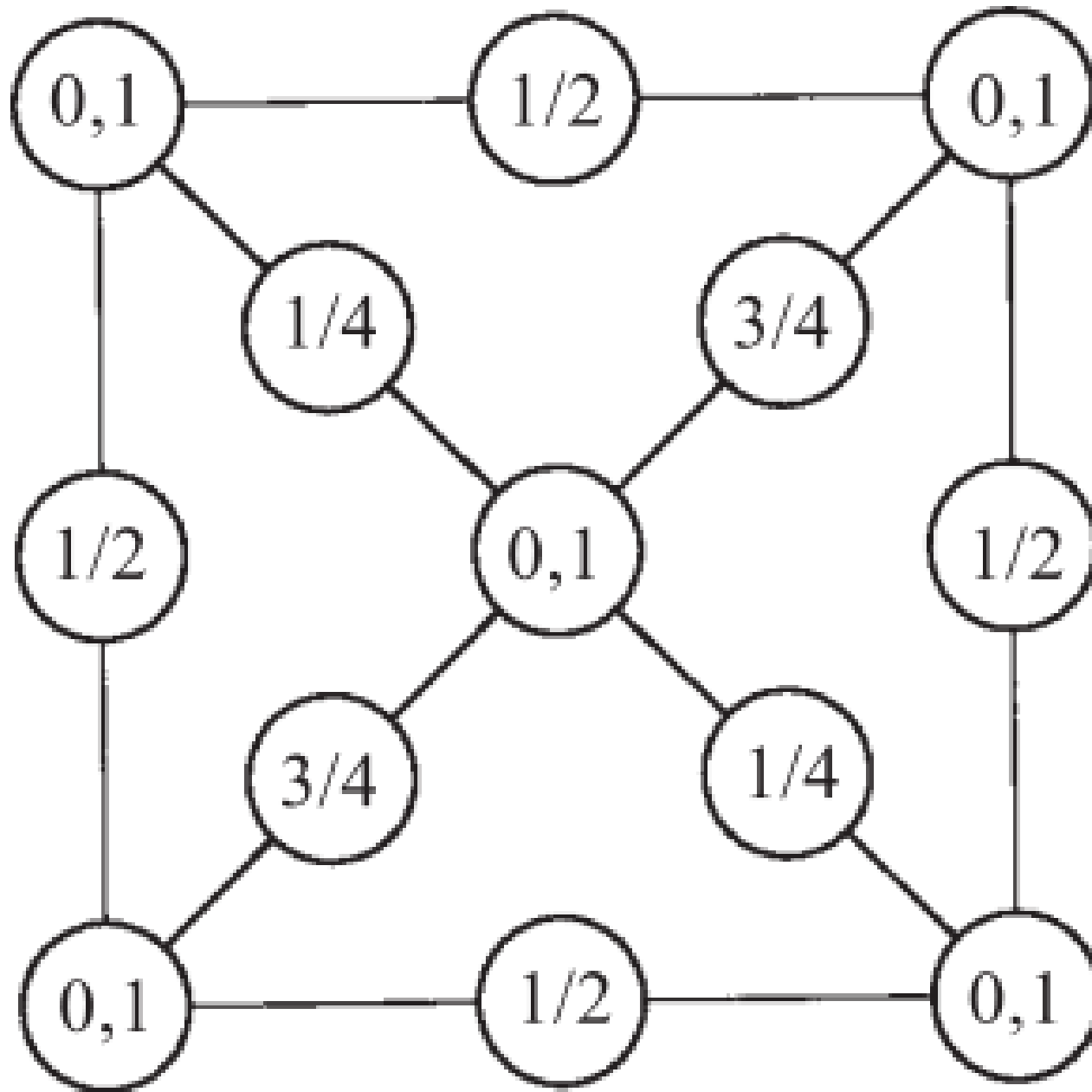
- Orbital hybridization of C atoms ( $sp^3$ ) requires that the atoms are tetrahedrally coordinated and thus the structure has high degree of directionality.
- One unit-cell consists of two **FCC lattices**, one at (0 0 0) and another at ( $\frac{1}{4}$   $\frac{1}{4}$   $\frac{1}{4}$ ).
- Only 50% of 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

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

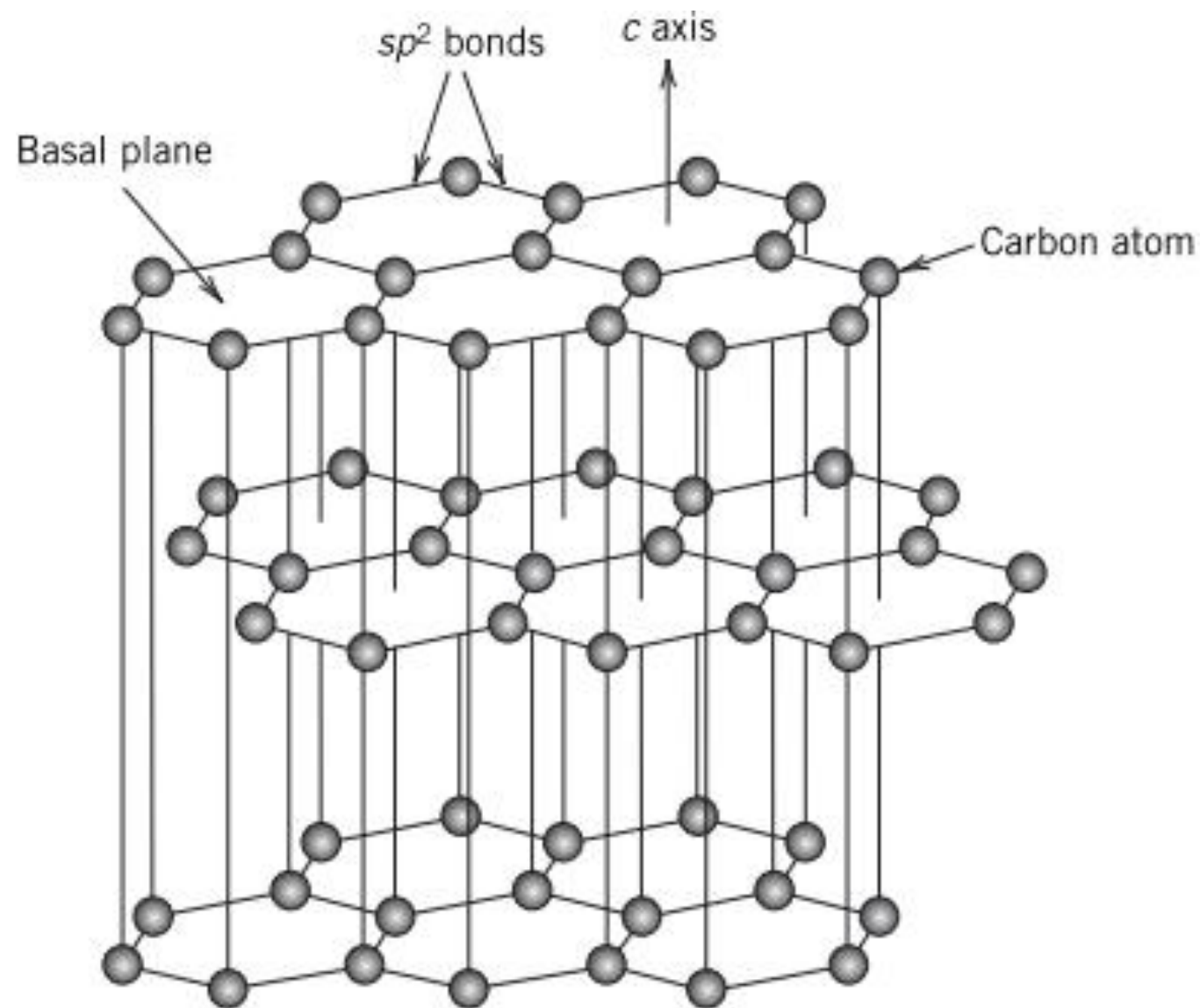
The relation between  $a$  and  $r$  is :  $\frac{1}{4} \times a\sqrt{3} = 2r$

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

Therefore,  $APF = 34\%$



## 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 Waals type of bonding. That is why Graphite is a soft material and is used as a lubricant.

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.