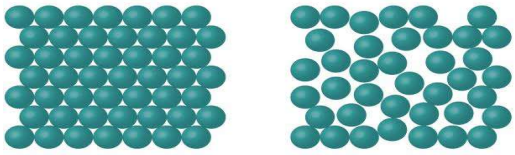
UNIT-1 CRYSTALLOGRAPHY AND MATERIAL CHARACTERIZATION

INTRODUCTION - UNIT CELL

INTRODUCTION

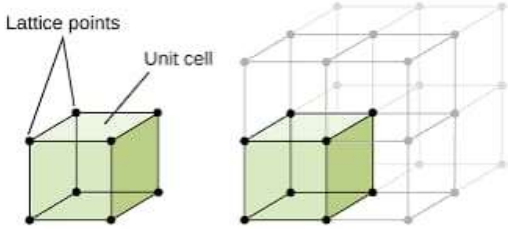
- The word “crystallography” is derived from the Greek words:
- **1.Crystallon**: Cold/frozen drop, which means extending to all solids with some degree of transparency. **2.Grapho**: Write.Hence crystallography means “the science of describing or writing about crystals.”
- Crystallography or crystal physics is the branch of physics that studies all types of crystals and their physical properties.
- It determines the actual structure of crystalline solids using x-rays, neutron beams, and electron beams.
- Solids can be broadly classified based on the arrangement of constituent units, like atoms, molecules, or ions. They are:
- **1.Crystalline Solids:** A substance where the arrangement of units of matter is *regular & periodic* is called a crystalline solid.
- Crystalline solids have *directional properties* and hence are called *anisotropic* substances.
- Crystalline Solids have a sharp range of melting points.
- **2. Non-crystalline/Amorphous Solids:** A substance where the arrangement of units of matter is in a *non-orderly manner (random distribution)* is called a non-crystalline/amorphous solid.
- Non-crystalline solids have a wide range of melting points and do not possess a regular shape.
- They *do not have directional properties* and so they are called *isotropic* substances.
- Examples: Glass, Plastic, Rubber.



Crystalline Amorphous

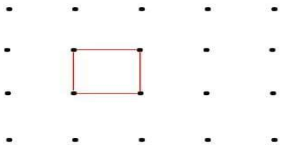
UNIT CELL

- The smallest repeating unit in a crystal lattice that shows the full symmetry of the entire crystal structure is called the unit cell.
- It acts as a fundamental building block, which can generate the complete crystal by repeating itself in 3-D space.

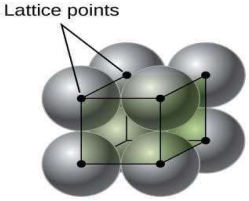


- The size and shape of the unit cell are decided by primitives (**a**,**b**,**c**) and interfacial angles (α,β,γ).

- Different ways of unit cells as follows

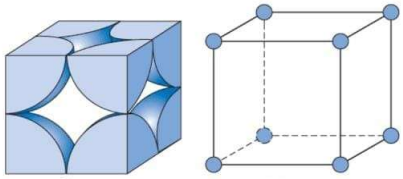


Unit cell in 2D

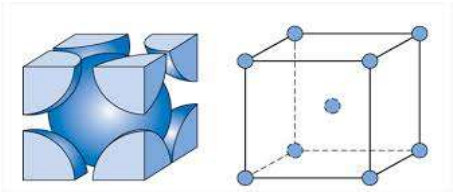


Unit cell in 3D

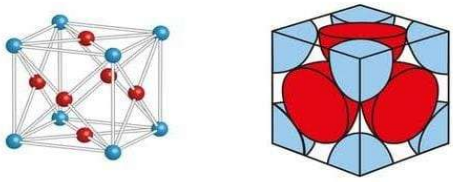
- A unit cell can be classified into two types:
- **1.Primitive unit cell (simple cell):**
- The Primitive unit cell contains lattice points *only at the corner*.
- The number of lattice points per unit cell is **1** and it is a *minimum volume* unit cell.
- Example: Simple Cubic unit cell.



- **2.Non-primitive Unit Cell (Multiple Cell):**
- A non-primitive unit cell contains lattice points at the *corners and at other positions within the cell*.
- Examples: I, F and C.
- **Body-Centered (I)**: Contains lattice points at *all corners* and one additional point *at the center* of the body.



- **Face-Centered (F**): Contains lattice points at *all corners* and one additional point at the *center of each of the six faces*.



- **Base-Centered (C)**: Contains lattice points at *all corners* and one additional point *at the center of two opposite faces(bases)*.