



SNS COLLEGE OF ENGINEERING

Coimbatore-641 107

(An Autonomous Institution)

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Approved by AICTE, New Delhi & Recognized by UGC

Affiliated to Anna University, Chennai

DEPARTMENT OF PHYSICS

COURSE NAME :19PY101-ENGINEERING PHYSICS

I YEAR / I SEMESTER

UNIT 4 – CRYSTAL PHYSICS

TOPIC - 7 CRYSTAL IMPERFECTIONS POINT DEFECTS, LINE DEFECTS –

BURGER VECTORS, STACKING FAULTS



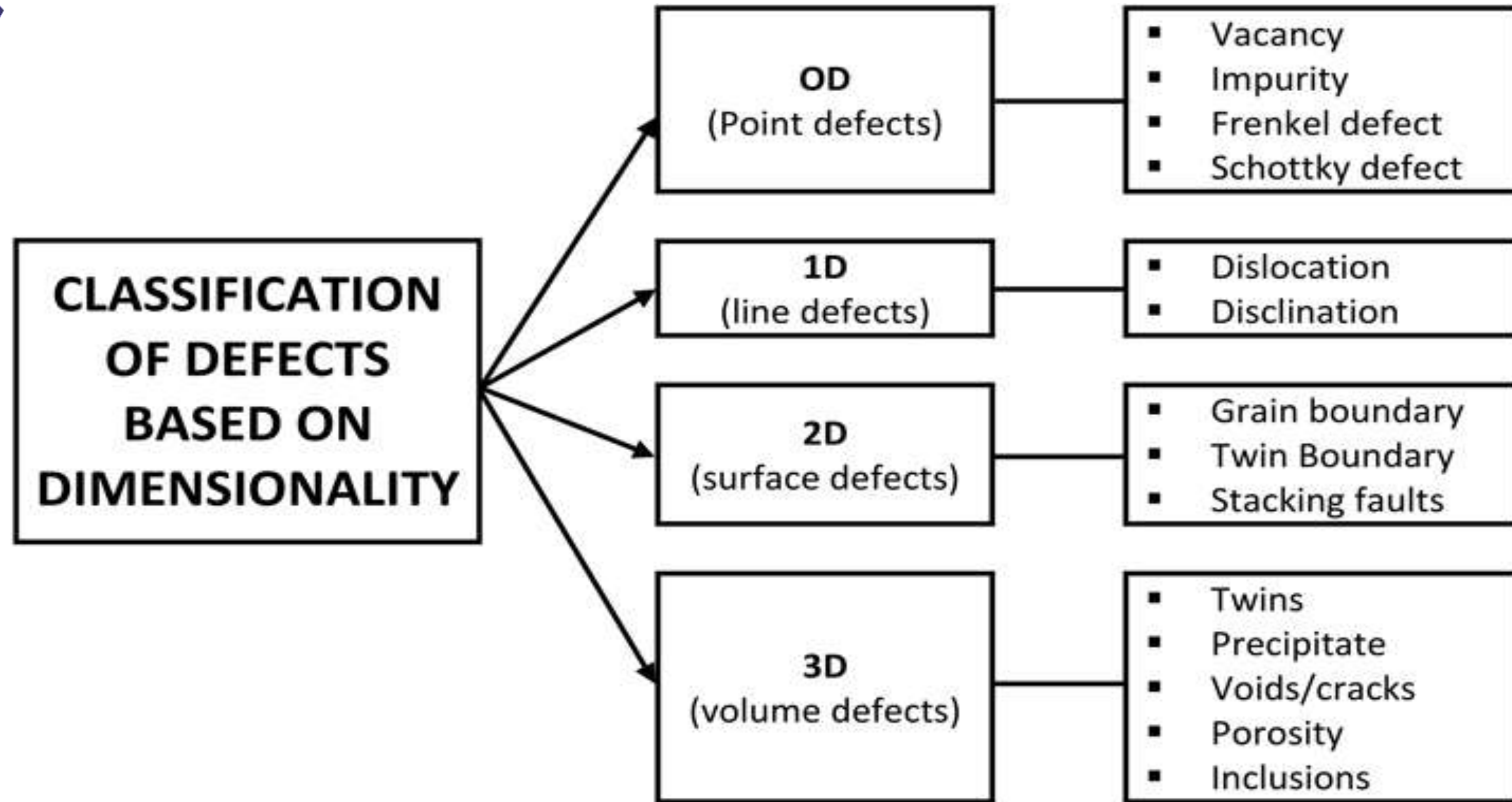


Crystal Imperfections

Crystal Imperfections are the defects in the regular geometrical arrangement of the atoms in a **Crystalline** solid. A Perfect **Crystal** is an idealization; there is no such thing in nature.

Crystal Defects

- **Point defects**, which are places where an atom is missing or irregularly placed in the lattice structure.
- **Linear defects**, which are groups of atoms in irregular positions.
- **Planar defects**, which are interfaces between homogeneous regions of the material.



Point defect

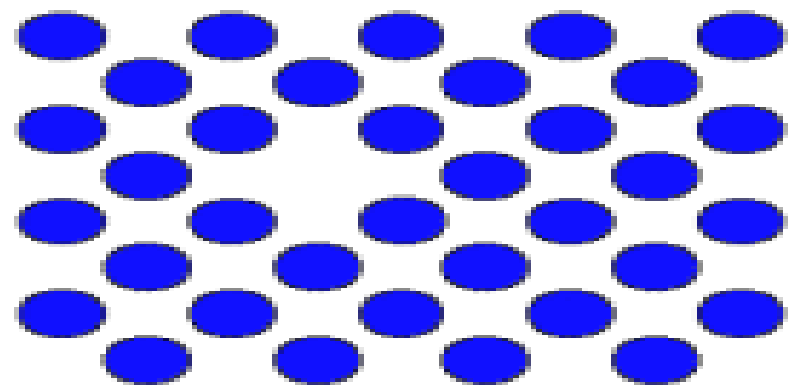
Point defects are **defects** that occur only at or around a single lattice **point**.

They are not extended in space in any dimension.

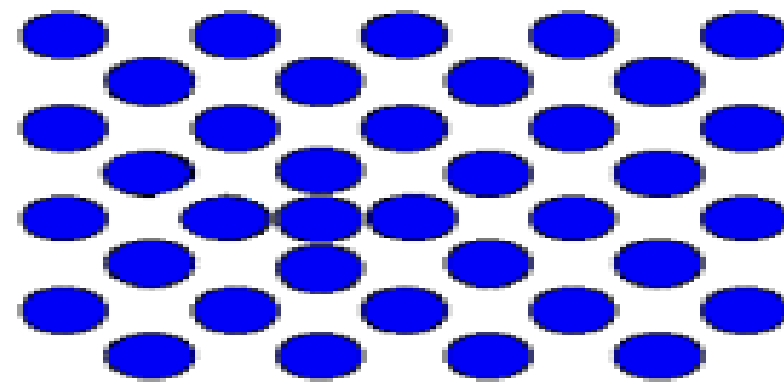
These **defects** typically involve at most a few extra or missing atoms.

Point defects include self interstitial atoms, interstitial impurity atoms, substitutional atoms and vacancies.

Intrinsic point defects

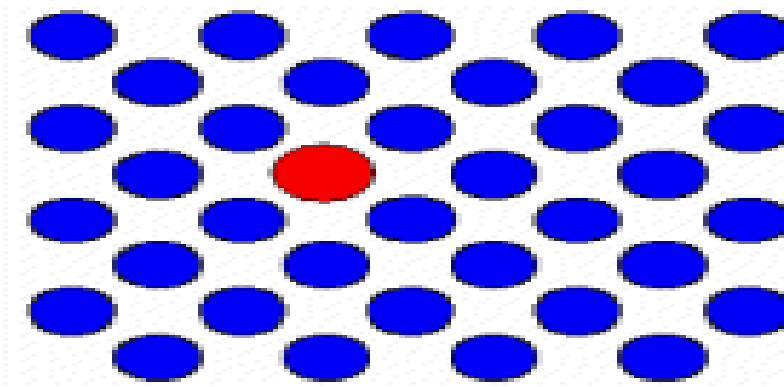


Vacancy

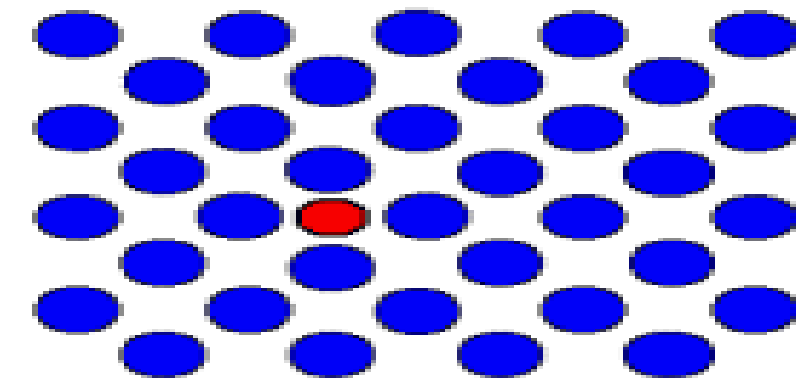


Self-interstitial

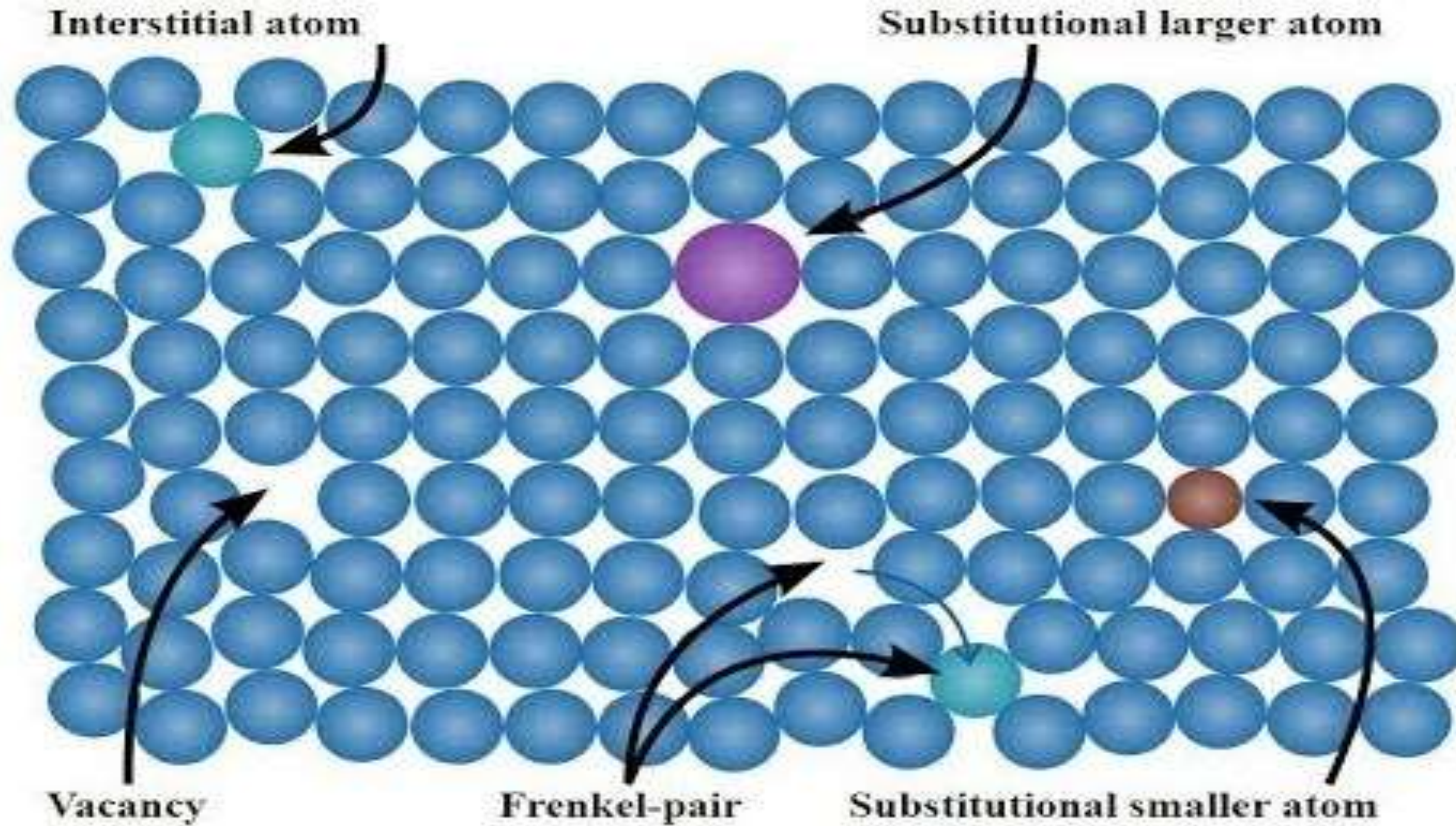
Extrinsic point defects



Substitutional
foreign atom



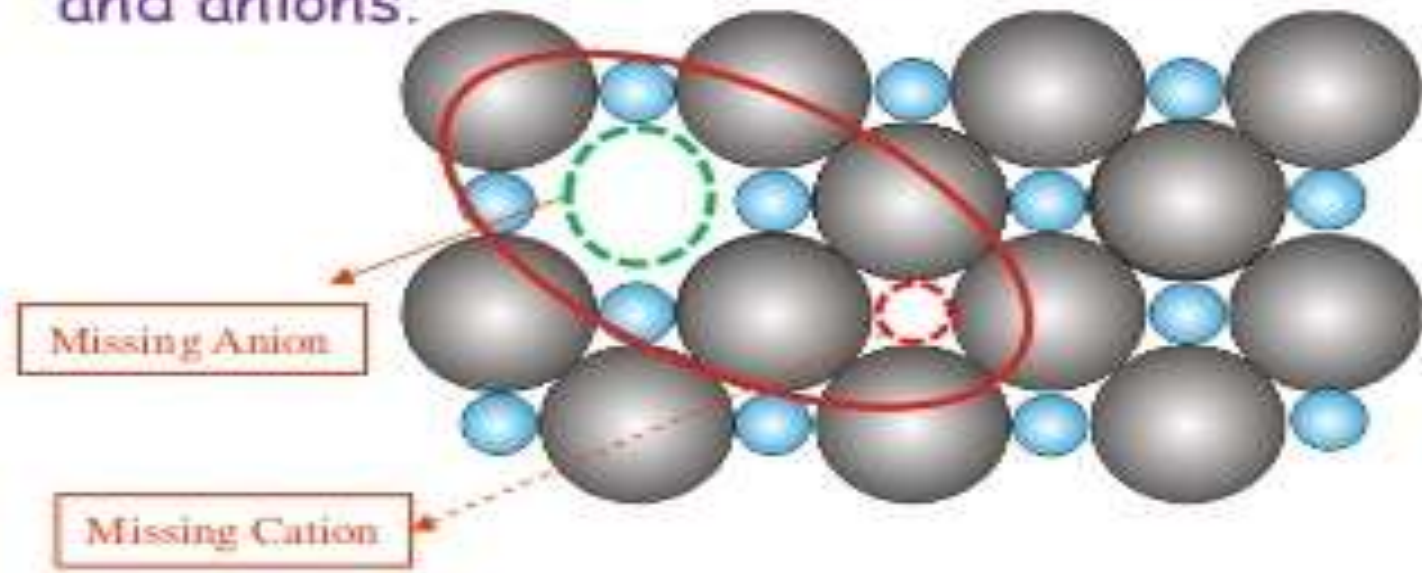
Interstitial
foreign atom



Schottky defect and Frenkel defect

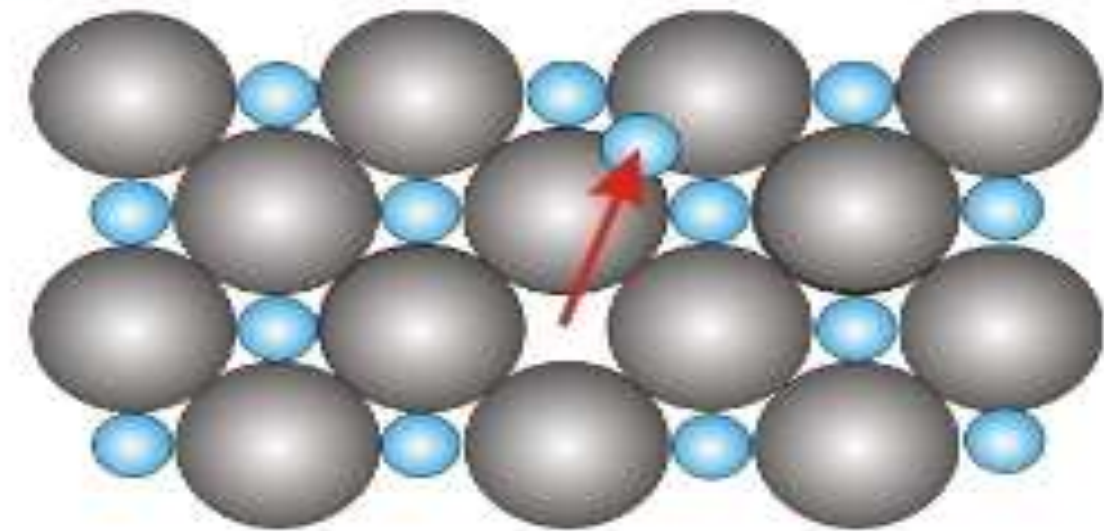
Schottky Defect:

- ❖ Forms when oppositely charged ions leave their lattice sites, creating vacancies.
- ❖ These vacancies are formed in stoichiometric units, to maintain an overall neutral charge in the ionic solid.
- ❖ Density of the solid crystal is less than normal
- ❖ Occurs only when there is small difference in size between cations and anions.



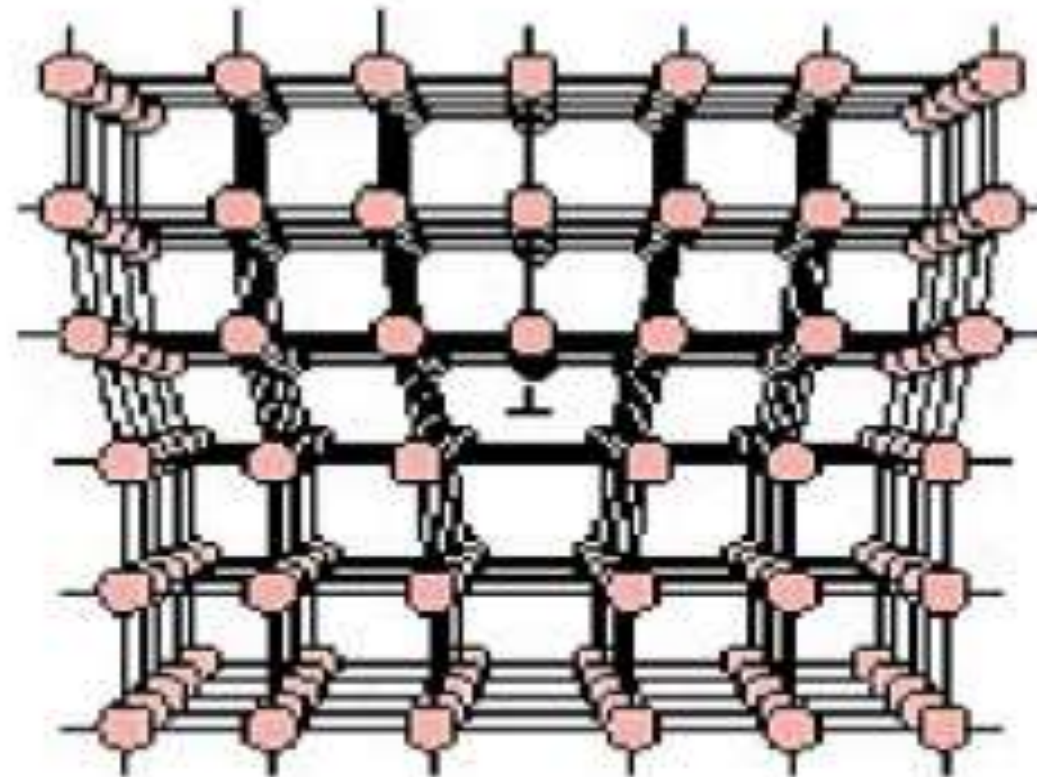
Frenkel Defect:

- ❖ Smaller ion (usually the cation) is displaced from its lattice position to an interstitial site.
- ❖ Creates a **vacancy defect** at its original site and an **interstitial defect** at its new location.
- ❖ Does not change the density of the solid.
- ❖ Shown in ionic solids with large size difference between the anion and cation.



LINE DEFECTS

- Line defects are the irregularities or deviations from ideal arrangement in entire rows of lattice points.



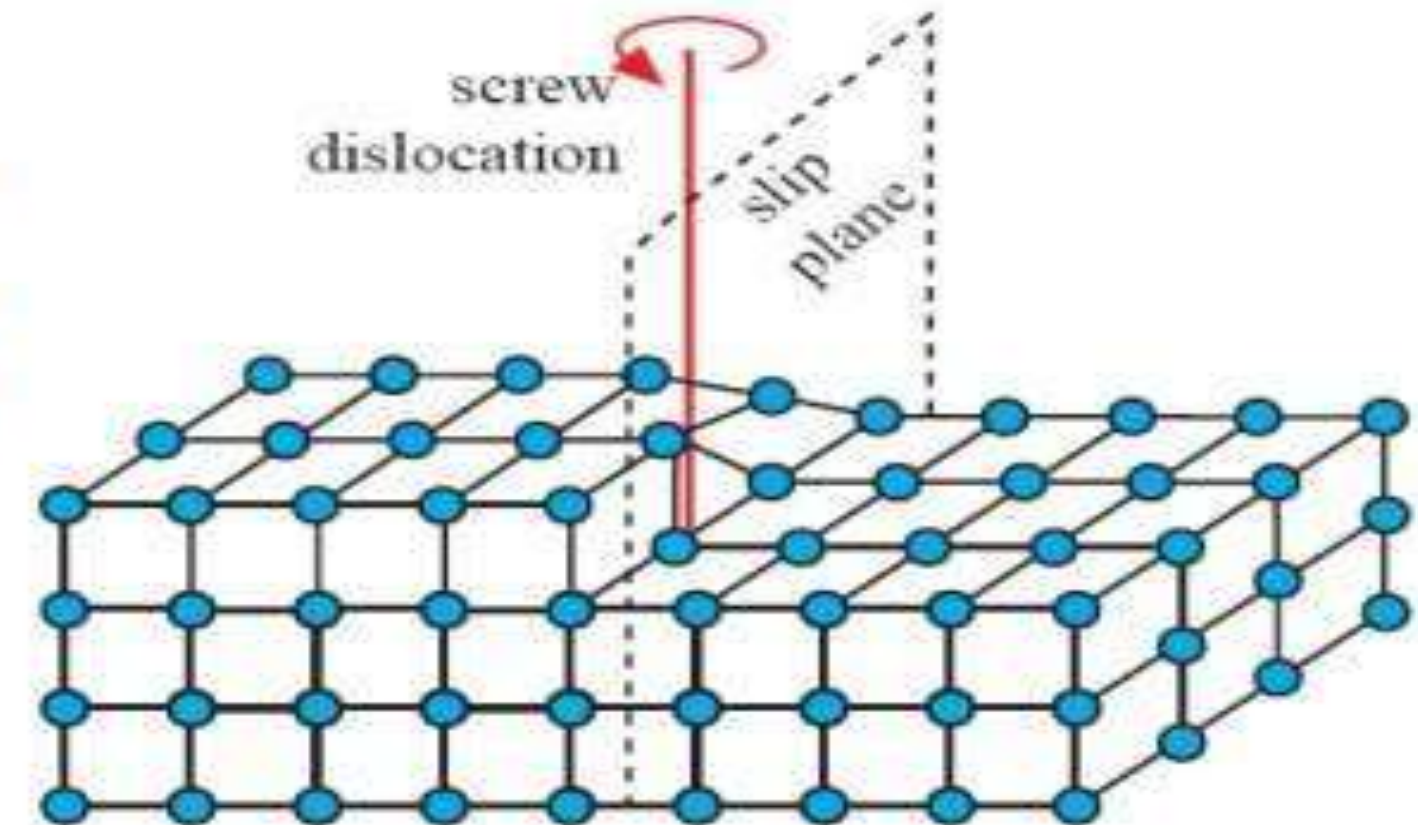
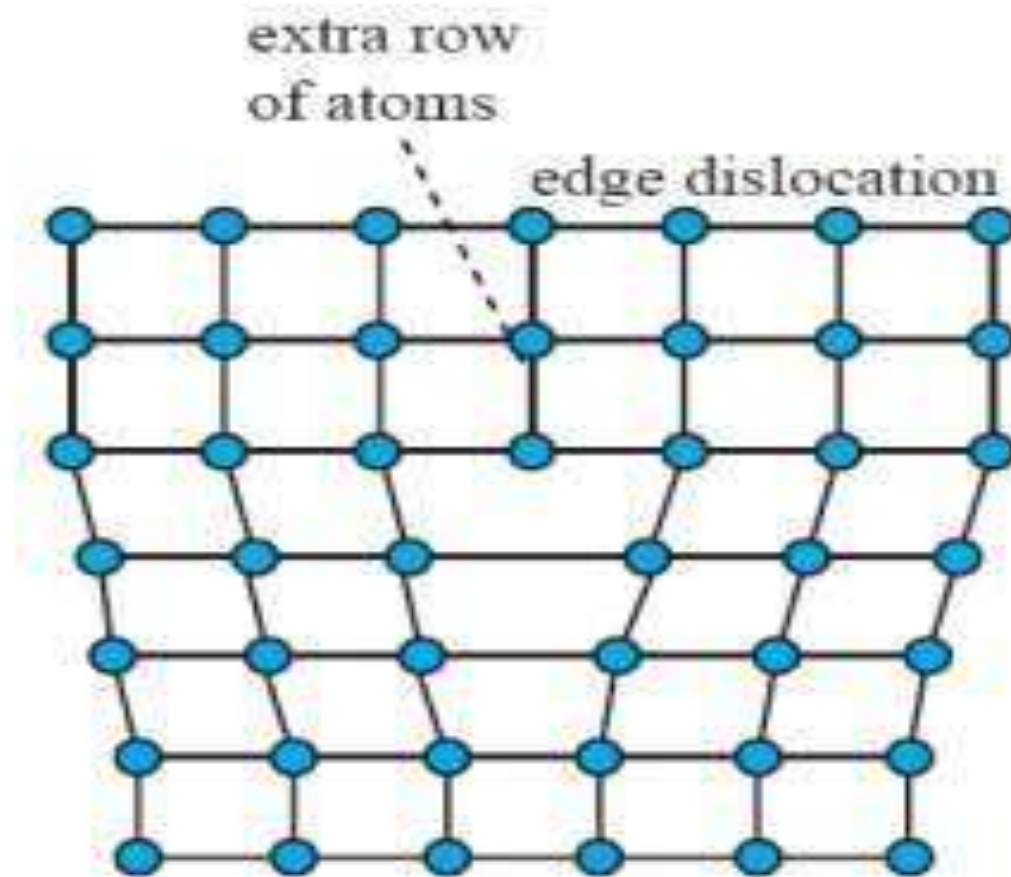
- Interatomic bonds significantly distorted in immediate vicinity of dislocation line.
- Dislocation affects the mechanical properties.

Line defect

Defect that is produced due to misalignment of atom in a crystal lattice.

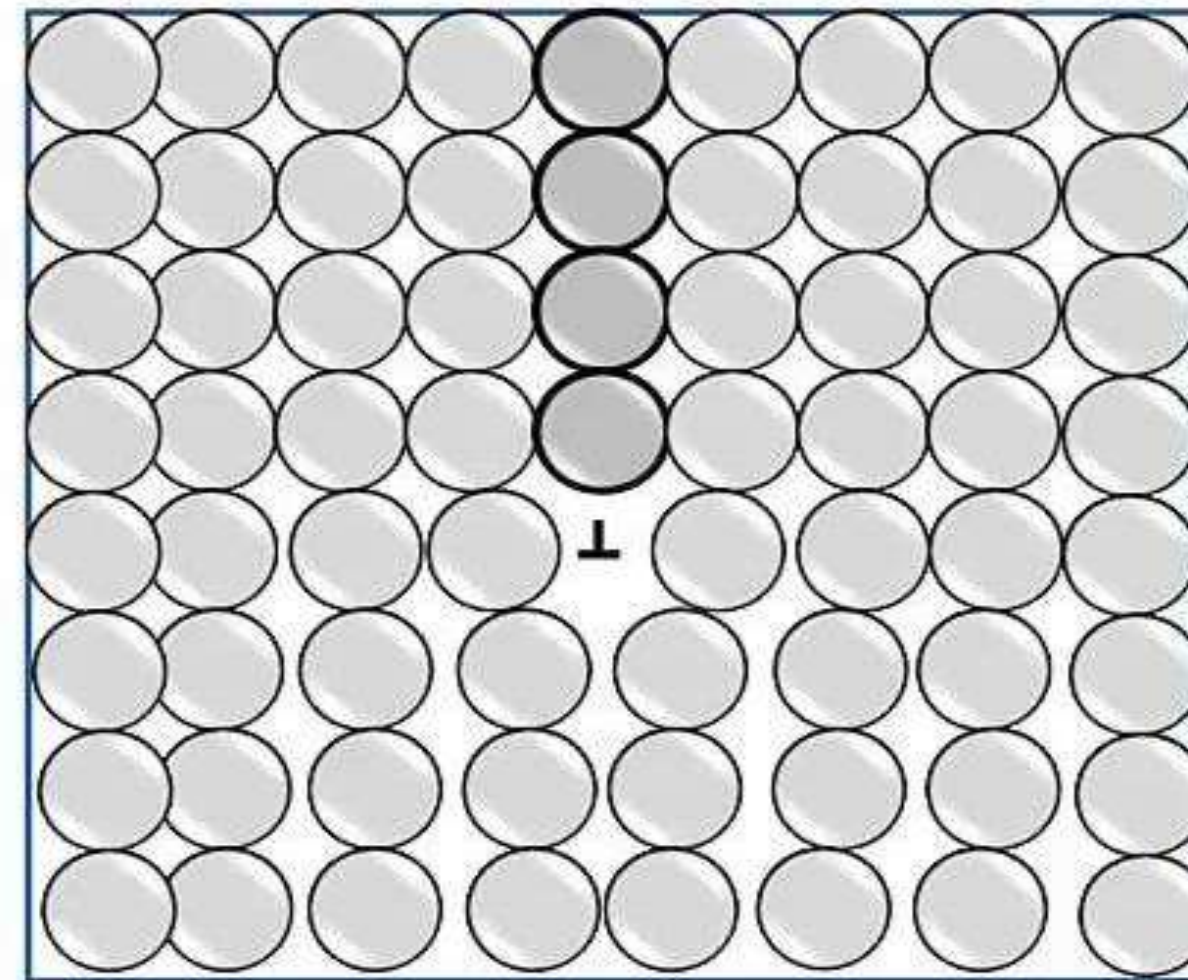
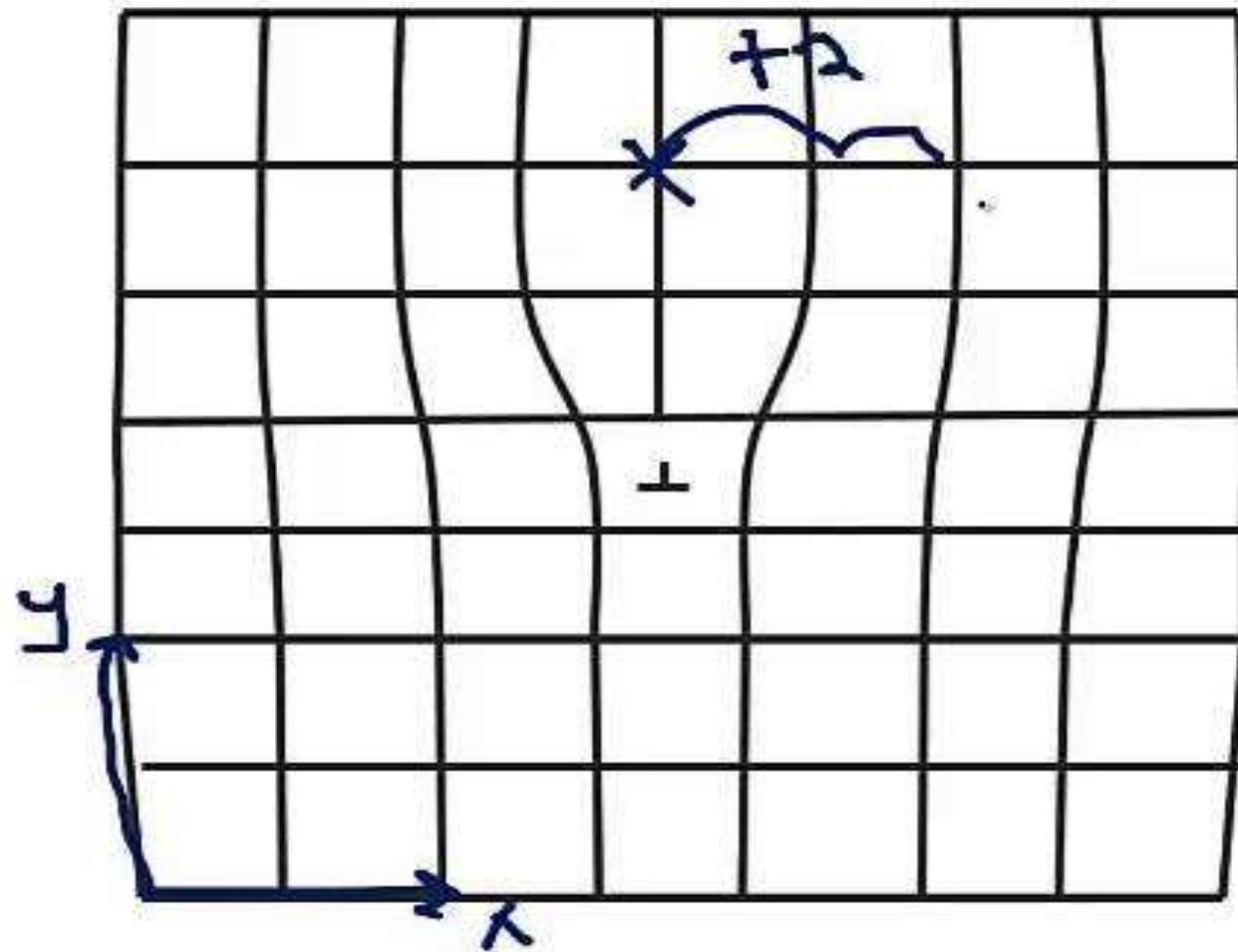
Line defect are produced two types of dislocation:

1. Edge dislocation
2. Screw dislocation



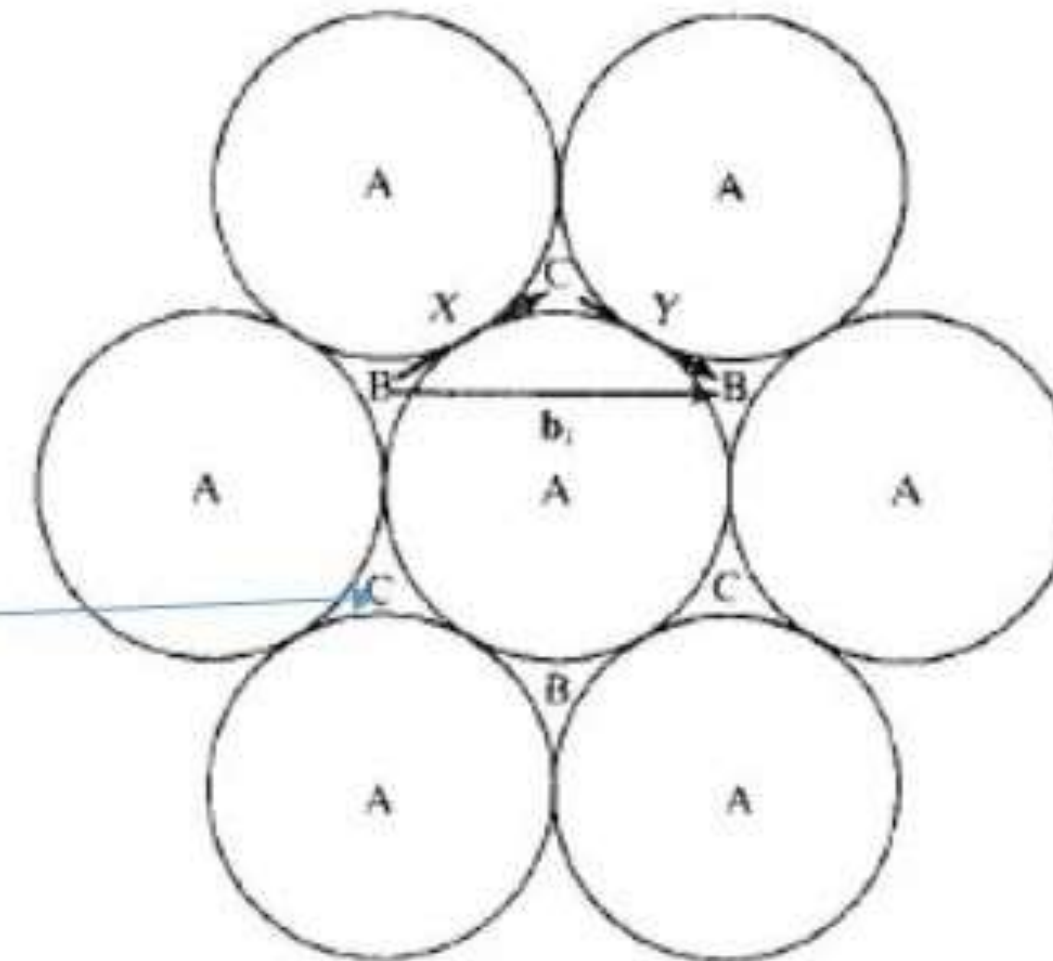
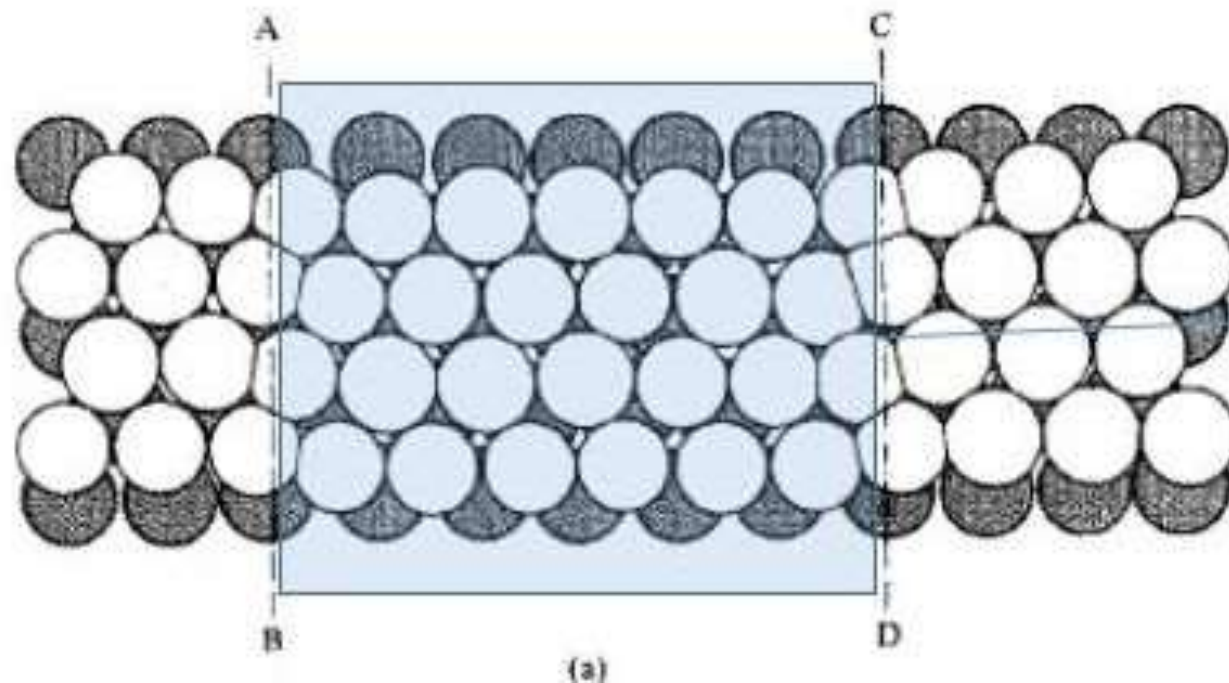
Edge Dislocation

Burger's Vector- The displacement vector that "closes the loop" when traversing an equal number of lattice steps around the defect.



STACKING FAULTS

- The shifted portion of the partial dislocation is a “stacking fault”
 - Atomic stacking order into the screen has changed
 - Was ABCA / BCABCABC ...
 - Now it is ABCA / CABCAABC ...





References



- <https://images.app.goo.gl/eTMrwSnBBycTdDgHA>
- <https://images.app.goo.gl/Sv4xEbBybX8k5ri27>
- <https://images.app.goo.gl/bckHATnNx3KsgHyd8>
- <https://images.app.goo.gl/nFecyk6vzG24Bedo6>
- <https://images.app.goo.gl/2FHgKV7rfZ87Qfez9>

Thank You