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CRYSTAL IMPERFECTIONS

(2 Marks)

Q.1 Define imperfection in crystal?

Ans: Imperfection in crystal is produced due to the misalignment of atoms, vacant of atom, distortion of lattice etc.in the metal structure.

Q.2 Classify crystal imperfection?

Ans: Crystal imperfection is classified in to

- Point defect-vacancies, interstialicies, impurities, electronic defects.
- Line defect-edge dislocation, screw dislocation
- Surface defect- grain boundaries tilt boundaries, twin boundaries
- Volume defect: cracks.

Q.3. What is deformation by slip?

Ans: Slip is that mechanism of deformation where in part of crystal moves, glides or slips over another part along certain planes known as slip planes.

- Deformation by slip is also known as shear deformation

Q.4. What is screw dislocation?

Ans:-Screw dislocation is a line defect which can be described as a linear disturbance of the atomic arrangement of a crystal where in a part plane of atoms is shifted from its stable and symmetrical position in the crystal.

- A screw dislocation lies parallel to its burger s vector. In screw dislocation the distortion follows a helical or screw path.

Q.5.What is imperfection in crystal?

Ans: Imperfection in crystal is produced due to the misalignment of atoms, vacant of atoms distortion of lattice .in the metal structure.

Q.6.What is schottky defect?

Ans: This is an ionic defect in which a cat ion and an anion are missing from a location so that electrical neutrality is maintained.

5 MARKS

Q.1. State various causes of dislocation?

Ans: Dislocation arise in crystal as a result of

- Growth accidents
- Thermal stresses

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- ❖ External stresses causing plastic flow
- ❖ Phase transformations
- ❖ Segregation of solute atoms causing mismatches etc.

Q.2. State the various causes of dislocation?

- Dislocation arise in a crystal as a result of
- Growth accidents
- Thermal stresses
- External stresses causing plastic flow
- Phase transformations
- Segregation of solute atoms causing mismatches etc.
- steel is heated to 20°c above lower temperature.

Q.3.Explain the cooling curve of pure iron?

Ans: The crystal imperfection less be grouped in to the following categories depending upon whether the defect is at a point, along a line or over a surface. All defects are classified under three main groups.

- ❖ Point defects
- Vacancies
- Interstialicies
- Impurities
- Electronic defect
- ❖ Line defects;
- Edge dislocation
- Screw dislocation
- ❖ Planner surface, interfacial or grain boundaries defects
- Grain boundaries
- Tilt boundaries,
- Twin boundaries.
- Volume defects

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7 MARKS QUESTIONS WITH ANSWERS

Q.1.Explain properties changes by deformation?

- Ans: Working hardening: Work hardening or strain hardening is a phenomenon which results in an increase in hardness and strength of metal subjected to plastic deformation at temperatures lower than the recrystallization range.
- Season cracking: In addition to the change in physical and chemical properties, internal stresses, often of very high intensity may be left in an object after cold deformation.
- Metal such as brass with internal stresses appearing after working is susceptible to inter crystalline corrosion. If it is stored for a long period. This leads to disintegration or failure of the metal. This phenomenon is called season cracking.

Strain ageing:

- If an alloy is overstrained in order to re move the yield point and is allowed to rest after plastic deformation it is found that the yield point returns with a higher stress when the alloy is reworked. This is called strain ageing and has a hardening effect on the metal.
- Preferred orientation: It has been seen in the foregoing articles that the grain of a polycrystalline material have random orientation .in cold working specially in those processes where severe plastic deformation takes place e.g. in cold rolling or wire drawing the metal grains tend to orient or align themselves in such a manner that they possess a common axial direction

Q.2.What is line defect?

Ans: The main two dimension or line defects are dislocation.

- A dislocation can be described as a liner distribution of the atomic arrangement of crystal wherein a part-plane of atoms is shifted from its stable and symmetrical position in the crystal.
- It can be conceived as a region of localized lattice disturbance which separates of localized lattice disturbances which separates the slipped region of the crystal from its unslipped region.
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The plastic deformation of metal due to slip phenomenon is mainly on account of dislocations only.

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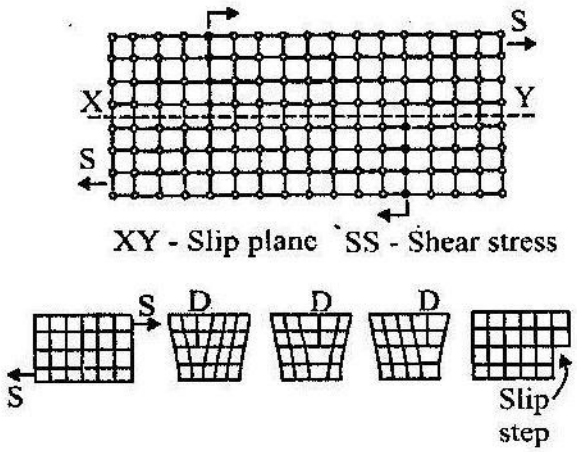
The two main types of dislocations are

- Edge dislocation
- Screw dislocation.

Q.2. Explain the different types of line defects?

Ans: Edge dislocation

- An edge dislocation lies perpendicular to its burgers vector.
- An edge dislocation moves in the direction of burger s vector.
- An edge dislocation involves an extra row atoms either above or below the slip plane. The presence of extra row means that adjacent atoms are displaced elastically.
- Under a shear stress positive dislocation moves to the right and negative dislocation to the left.
- The edge dislocation is particularly useful in explaining slip in plastic flow during mechanical working.



Screw dislocation:

- A screw dislocation lies parallel to its burgers vector.
- A screw dislocation moves in a direction perpendicular to the burgers vector.
- In the screw dislocation the dislocation follows a helical path or screw path and both right hand left hand senses are possible.

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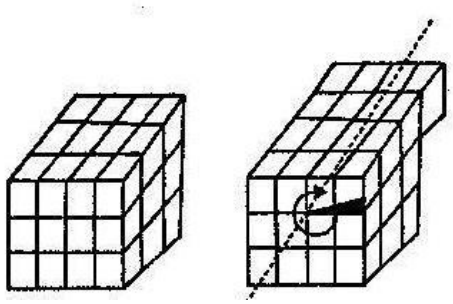

- Speed of movement of screw dislocation is less than that edge dislocation.
- Screw dislocation is especially useful in explaining crystal growth as well as slip in plastic deformation .

Q.3 Describe different types of point defects?

Ans(a)If the imperfection takes place in point like regions in the crystal then it is called point defect or point imperfection. It is also referred as zero dimension imperfection. Various types of point defect are as described below.

- Vacancies: It is a simplest point defect. Vacancies are simply empty atom sites.
  Causes: such defect may arise either from imperfect packing during the original crystallization.
  They may arise from thermal vibration atoms at high temperature, because as the thermal energy is increased there is a higher probability that individual atoms with jump out of their position of lower energy.
- Number of vacancies may occur by extensive plastic deformation(cold working) Vacancies maybe single, or two or more.
- Schottky effect is closely related to vacancies and is formed when an ion is removed from a normal lattice site and replaced in an average position on the surfaceof crystal.

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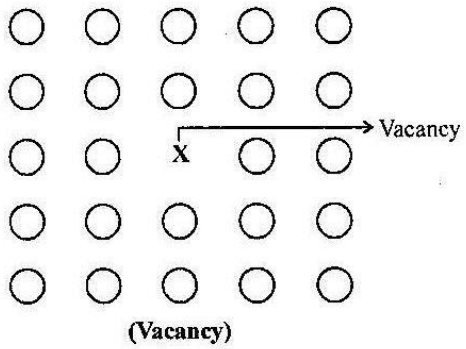
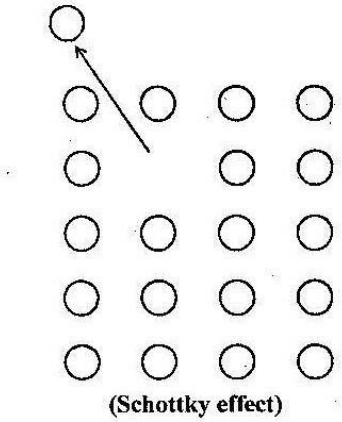


(Vacancy)



(Schottky effect)

- interstitial:

  An interstitial defect arise when an atom occupies a definite position in lattice that is no.s occupied in perfect crystal.

- In interstitial atoms occupied between atoms of ideal crystal.

  The interstitial atom may be lodged with in a crystal structure, particular if the atomic packing factor is low.

  Interstitial may be single interstitial, di- interstitial and tri – interstitial.

- The vacancy and interstitials are therefore inverse phenomena.

  Frankel defect is closed related to interstitial. An ion displaced from the lattice in to an interstitial site is called frankel defect.

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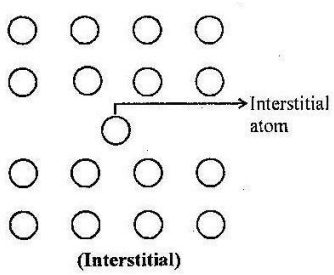
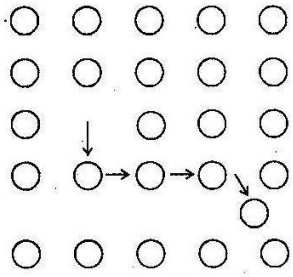


(Interstitial)

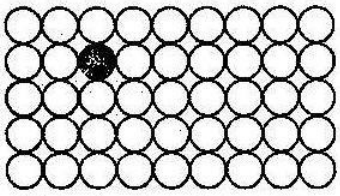


(Frankel defect)

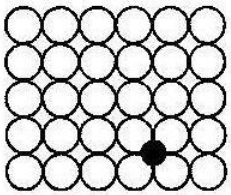
Impurities:

It gives rise to compositional defect.

- Impurity atoms are introduced in to crystal structure as substitution or interstitial atoms.
- Impurity defects occurs in metallic covalent and ionic solid.



(Substitutional impurity)



(Interstital impurity)

Electronic defect:-

Due to electronic defect charge distribution takes place in solids. This effect is responsible for operation of P-n junctions and transistors.