paper code: U218-156(T1) Model Answers

OCTOBER 2018/ IN-SEM (T1)

S. Y. B. TECH. (MECHANICAL ENGINEERING) (SEMESTER - I)

COURSE NAME: MATERIAL SCIENCE AND ENGINEERING METALLURGY

COURSE CODE: MEUA21176

(PATTERN 2017)

[Max. Marks: 30]

Q.1)

a) Define the following [6 marks]

1. Lattice

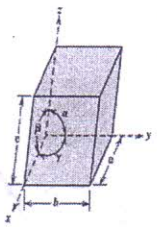


FIGURE 3.4 A unit cell with x, y, and z coordinate axes, showing axial lengths (a, b, and c) and interaxial angles (α, β, and γ).

2)Lattice angle An angle made by two lattices with each other is known as Lattice angle

3) Lattice parameter

- Lattices in three dimensions generally have three lattice constants, referred to as a, b, and c. This dimensions to a lattice are known as Lattice parameter

b) Determine what do you mean by the crystal imperfection? Explain the edge dislocation with a neat diagram. [6 marks]

- The term ***"defect"*** or ***"imperfection"*** is generally used to describe any deviation from perfect periodic array of atoms in the crystal.

One-dimensional (linear) defects Edge dislocation

The defects, which take place due to dislocation or distortion of atoms along a line, in s direction are called as '***line defects***'.

A dislocation may be defined as a disturbed region between two substantially perfect parts crystal.

It is responsible for the phenomenon of slip by which most metals deform plastically

- If one of vertical planes does not extend to the full length, but ends in between within the cr it is called '***edge dislocation***'.

Edge Dislocation

Edge Dislocation

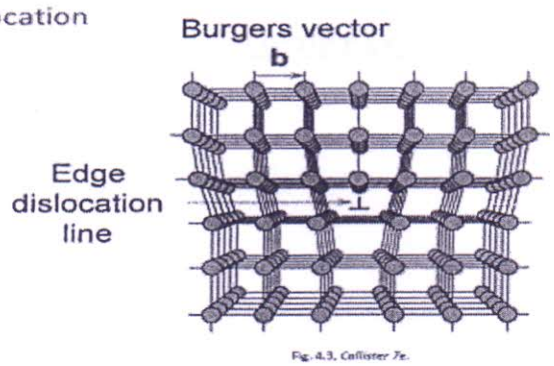


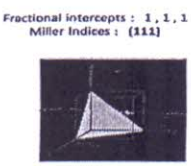
Fig. 4.3, Callister 7e.

-

EDGE DISLOCATION

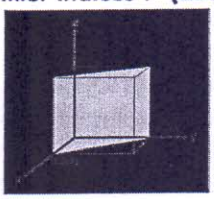
- Edge dislocations are represented by '⊥' or 'T' depending on whether the incomplete plane starts from the top or from the bottom of the crystal.
- These two configurations are referred to as positive and negative edge dislocations respectively.

c) Show the following planes in a cubic cell: 1. .(111) [4 marks]



2. (110)

Intercepts : a, a, ∞
Fractional intercepts : 1, 1, ∞
Miller Indices : **(110)**



OR

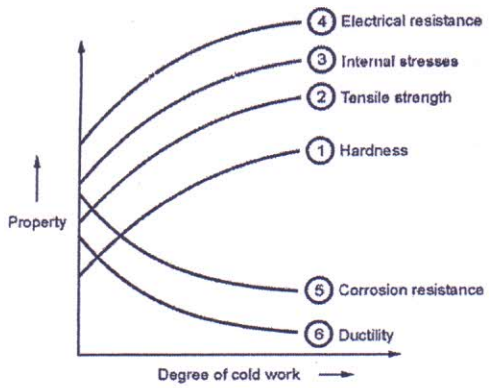
Q.2)

a) Define the following [6 marks]

1. Surface defect:
   Two-dimensional (flat) defects. Surface. Surface imperfections arise from a change in the stacking of atomic planes on or across a boundary.
   Antiphase boundary, shear plane, low angle twist boundary, low angle tilt boundary, grain boundary,.

2. Dislocation density: this is defined as no of dislocation per unit length. It is as high as in cold worked material can be reduced by Annealing.
3. Internal stresses: Internal stresses are developed in materials due to either solidification or movement of dislocation or /any point defect. Anything which increases internal defects will increase internal resistance and in reverse increases hardness and strength
   :

b) Show properties before annealing on graphical and explain [6 marks]



1 and 2: Anything which increases internal defects will increase internal resistance and in reverse increases hardness and strength

3: Internal stresses are developed in materials due to movement of dislocation or /any point defect

4: Due to change in internal crystal structure electrical resistance increases

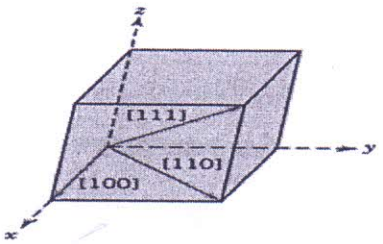
5: Due to increase in hardness and strength ductility is reducing

6: Due to increase in internal stresses anodic and cathodic areas are formed, The grain boundary becomes high energy due to dislocation movement along that and grain boundary becomes anodic so intergranular corrosion increases and corrosion resistance decreases

c) With a suitable sketch show the following on a cubic cell [100] [110] [4 marks]

Separate crystal structure is required

Specifying Directions in Crystals



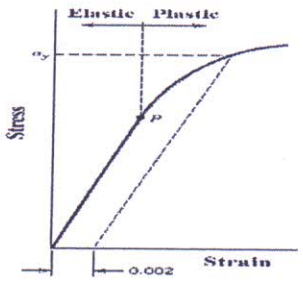
Q.3)

a) Define plastic and elastic deformation with proper example. [6 marks]

- A temporary shape change that is self-reversing after the force is removed,] so that the object returns to its original shape, is called **Elastic Deformation**
- When a sufficient load is applied to a metal or other structural material, it will **cause** the material to change shape **Plastic Deformation.**

- The Cu wire will permanently change its length and dimension is known as **Plastic Deformation**
- it's a plastic deformation and rubber will regain its original shape on the removal of applied force is a elastic deformation

Till yield the deformation is elastic and obey and the deformation in linear Hooks Law and after the yield it does obey Hooks Law the deformation in nonlinear



b) Explain how many systems are existing in FCC metal and why slip is more? [4 marks]
in FCC than in HCP.

Slip planes: preferred planes with greatest interlunar distance with ,<110> , **highest planar Densities** e.g., (111) in fcc crystal structure where burgers vector is less

Slip directions: with lowest resistance and closed planes are more in FCC

Slip systems are Slip planes ×Slip direction and they are

{111} planes 4 with <110> diction are 3 so total is 12 systems are FCC metal

where as in HCP metal they are 2 so in FCC metal slip is more than HCP metal

c) Compare advantages of Dye penetrant test and Ultrasonic test [4marks]

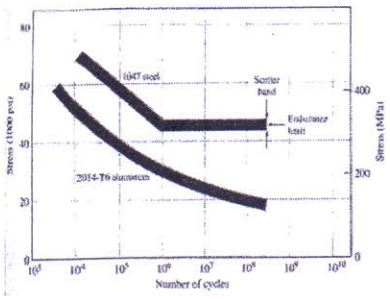
Dye penetrant test	Ultrasonic test
This method is an inexpensive and convenient technique for surface defect inspection	This method is an expensive and Non convenient technique for surface defect inspection
Needs no skilled person	Needs skilled person
Can be used for surface as well as porous pow metallurgical component	Can be used for internal defects
Needs no surface preparation	Surface needs to be flat or grinding is requ before the test
Couplent is not required	Couplent is required before test
Result can be seen immediately	Result can be stored on computer
Electricity is not required	Electricity is required for transducer
Large component can be done at one time	Large component can be done at one time if it is done it sections and results are stored in computer
Used in process	Is used for thickness measurement

OR

Q.4)

a) Define Endurance limit, creep strength and Fatigue strength [6 marks]

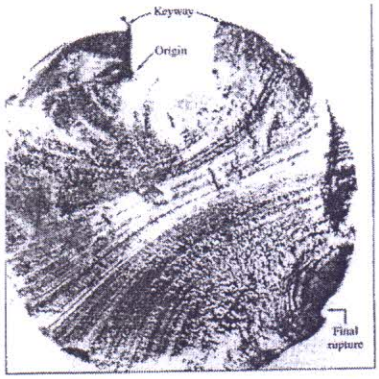
Endurance limit - An older concept that defined a stress below which a material will not fail in a fatigue test. Or it is defined as a stress at which the S-N diagram becomes flat



- In materials science, creep is the tendency of a solid material to move slowly or deform permanently under the influence of mechanical stresses or at constant stress with time dependent strength is defined as creep strength

Fatigue Strength - The number of cycles permitted at a particular stress before a material fails by fatigue. This strength is defined as fatigue strength

b) Write the characteristic's of fatigue fracture [4 marks]



1. This always start on surface
2. This is perpendicular to applied stress
3. This always initiate in stress raising points
4. It always goes in metal by beach marks
5. It always gives less energy or fails in brittle manner in the end
6. It is always transgranular or intergranular in nature

c) For detecting the cracks in bronze metal part magnetic particle Test can be used'. True or false? Justify your answer [4 marks]

No

In magnetic particle test the test specimen is becoming magnetic by passing a current and iron powder is spread on surface which Creates local South and North field where ever the crack or discontinuity is present and attracts the iron powder in crack and detects the crack in magnetic material.

Bronze is a non magnetic and nonferrous alloy cannot be magnetized so Magnetic Particle test can not be performed on this.

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[Max. Marks: **30**]

Marking Scheme

Q.1)

a) Define the following

1. Lattice Dimension 2)Lattice angle 3) Lattice parameter [6 marks]

2 marks for each definition

b) Determine what do you mean by the crystal imperfection? Explain the Edge dislocation with a neat diagram. [6 marks]

1 mark for imperfection

3 for explanation

2 for diagram

c) Show the following planes in a cubic cell: 1. (111) 2. (110) [4 marks]

2 marks for each for showing on crystal structure

OR

Q.2)

a) Define the following

1. Surface defect.2. Dislocation density 3.Internal stresses [6 marks]

2 marks for each definition

b) Show properties before annealing on graphical and explain [6 marks]

2 marks for diagram 4 for explanation

c) With a suitable sketch show the following on a cubic cell [100] [110] [4 marks]

2 marks for each for showing on crystal structure

Q.3)

a) Define plastic and elastic deformation with proper example. [6 marks]

2 marks for each for showing the change with one example and 2 for Stress strain diagram

b) Explain how many systems are existing in FCC metal/ And why slip is more in FCC than in HCP. [4 marks]

1 mark for answer and 3 marks for explanation

c) Compare advantages of Dye penetrant test and Ultrasonic test [4marks]

minimum n 4 important points

OR

Q.4)

a) Define Endurance limit, creep strength and Fatigue strength [6 marks]

2 marks for each definition

b) Write the characteristic's of fatigue fracture [4 marks]

Diagram 1 mark and 3 for characteristics

c) For detecting the cracks in bronze metal part magnetic particle. Test can be used'. True or false? Justify your answer [4 marks]

1 mark for answer 1no and 3 marks for explanation