[103/A15] SEAT No._____ [No. of Printed Pages: 02]

SARDAR PATEL UNIVERSITY
M.Sc. (Physics) (IVth –Semester) Examination (CBCS)
Tuesday, Date: 26/03/2019
Time: 10.00 a.m. to 01.00 p.m.
Subject: CRYSTAL GROWTH AND IMPERFECTIONS IN SOLIDS
Subject Code: PS04EPHY02 (OLD)

Instructions:
(a) Figures to the right indicate marks.
(b) Answer of all the questions (including MCQs) should be written in the provided answer book only.

Total Marks : 70

Q.1 Write answer of all questions by showing your choice against the question number in main answer book. [8]

(1) A plot of temperature corresponding to upper points on the cooling curve against suitable alloy composition is called _____.
(a) liquidus line (b) solidus line (c) Peritectic line (d) none

(2) _____ technique is used to remove impurities and trapping centers from crystals.
(a) Verneuil flame fusion (b) Brigdman (c) Czochralski (d) floating zone

(3) The angle between edge dislocation line and the Burger's vector is _____.
(a) 0^0 (b) 45^0 (c) 90^0 (d) 180^0

(4) Surface imperfection in a crystal is _____ dimensional defects.
(a) 0 (b) 1 (c) 2 (d) 3

(5) Which technique is preferred for viewing dislocations in crystals which are transparent to light?
(a) decoration (b) electron Microscopy
(c) X-ray diffraction (d) field ion microscopy

(6) Which dislocation is free to move on any of the several planes in which the Burger's vector lies?
(a)edge (b) screw (c) mixed (d) none of these

(7) In brittle fracture, cracks may spread extremely rapidly with very little accompanying plastic deformation. Such cracks are said to be _____.
(a)unstable (b) stable (c) metastable (d) twisting

(8) The process in which carbon is lost in the form of CO or CO_2 from surface layers of the steel due to an oxidizing atmosphere is called as:
(a)carburizing (b) nitriding (c) decarburizing (d) surface hammering

Q.2 Attempt any Seven questions of the following: [14]
(1) Draw a labeled diagram of Bridgman crystal growth technique and mention its requirements.
(2) Describe properties of the solvent used for growth of crystals from solution.
(3) Differentiate between Bridgman and pulling method used for crystal growth.
(4) How tilt boundary form in crystalline material?

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(5) Determine the fraction of atoms in a given solid with the energy equal to or greater than 1.5 eV at room temperature (300 K) and at 1500K.

(6) What are colour centers? Explain how F-centers are formed in alkali halide crystal with giving specific reason.

(7) Define the terms : slip plane, slip direction, glide and climb.

(8) Distinguish between ductile fracture and brittle fracture.

(9) Explain decarburizing process in steel.

Q.3(a) Draw cooling curve for pure material, binary system and binary eutectic system and calculate number of degree of freedom for each case using Gibb's phase rule for condensed system. [6]

Q.3(b) Draw a phase equilibrium diagram of two component system that are mutually soluble in liquid state and completely insoluble in solid state and calculate amount of solid and liquid phase is present using lever rule. [6]

OR

Q.3(b) Using suitable diagram describe the growth procedure crystals using vapour transport technique. [6]

Q.4(a) Define Frenkel defect in solid? Obtain the equation to calculate concentration of Frenkel defects for ionic crystal. [6]

Q.4(b) What is dislocation? Describe the motion of dislocation after applied shear stress to the crystalline solids using necessary diagram. [6]

OR

Q.4(b) What is Stacking fault? Describe different ways in which stacking fault is produced in fcc and hcp crystal. [6]

Q.5(a) Discuss cross-slip and double cross-slip process. Explain how edge dislocation can move out of its slip plane by a process called climb. [6]

Q.5(b) "To account for the large plastic strain, that can be produced in crystals, it is necessary to have regenerative multiplication of dislocations". In connection to this statement explain the two mechanisms known to you in detail. [6]

OR

Q.5(b) Derive the expression for the stress required to bend a dislocation to a radius R. Also provide simple semi-qualitative approach by which forces between dislocations can be explained. [6]

Q.6(a) How diffusion in solids occur? Derive Fick's first law of diffusion and explain the experimental methods used to determine the diffusivity in solids. [6]

Q.6(b) What are stress raisers? Explain Griffith theory of brittle fracture. [6]
A relatively large plate of a glass is subjected to a tensile stress of 40 MPa. If the specific surface energy and modulus of elasticity for this glass are 0.3J/m^2 and 69GPa, respectively. Then determine the maximum length of a surface flaw that is possible without fracture

OR

Q.6(b) Define fatigue and discuss about various cyclic stresses. Explain in detail about S-N curve along with the experimental fatigue testing apparatus. [6]

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