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[34/A-6]

SARDAR PATEL UNIVERSITY  
M.Sc. (Physics) (IV<sup>th</sup> -Semester) Examination

Day & Date : Saturday, 29/10/2016

Time: 02.00 p.m. to 05.00 p.m.

Subject: CRYSTAL GROWTH AND IMPERFECTIONS IN SOLIDS

Paper No. : PS04EPHY02

Instruction:

Figure to the right indicate marks.

Total Marks : 70

- Q.1 Write answer of all questions by showing your choice against the question number in main answer book. [8]
- (1)  $p^H$  is \_\_\_\_\_ should be necessary for the growth crystals from gel.  
(a) less than 7 (b) grater than 7 (c) zero (d) (d)none of the above
  - (2) For growth of ruby from flux, then after growth, the flux is dissolved in:  
(a) Sulphuric acid (b) Hydrochloric acid (c) Nitric acid (d) acetic acid
  - (3) Line imperfection in a crystal is \_\_\_\_\_ dimensional defects.  
(a) 0 (b) 1 (c) 2 (d) 3
  - (4) An atom displaced to interstitial site creating nearby vacancy is called:  
(a) interstitial (b) Schottky defect (c) Frenkel defect (d) Grain defect
  - (5) Three adjacent F – centers form \_\_\_\_\_ centers.  
(a) V (b) M (c) R (d) H
  - (6) \_\_\_\_\_ technique is preferred for viewing dislocation in crystals which are transparent to light.  
(a) Decoration (b) Electron microscopy  
(c) X-ray diffraction (d) Field ion microscopy
  - (7) Fatigue strength of the material decreases during the process of \_\_\_\_\_.  
(a) atomic diffusion (b) carburizing (c) decarburizing (d) ionic diffusion
  - (8) The process in which carbon is lost in form of the steel due to CO or CO<sub>2</sub> 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 of the followings: [14]
- (i) Define: Phase, boiling point, freezing temperature and Peritectic reaction.
  - (ii) Explain horizontal floating zone crystal growth technique in brief.
  - (iii) What type of furnace has been used for the growth of crystals from vapour transport technique? Why?

- (iv) Draw Burgers circuit in crystalline material and explain its process in brief.
- (v) How stacking faults produce in fcc crystal by inserting an extra plane?
- (vi) What is cross slip process?
- (vii) Explain in brief stress field of a dislocation.
- (viii) The diffusion co-efficient in germanium at 500 °C is of the order of  $10^{-10}$  m<sup>2</sup>/s. What is approximate distance of penetration in 1 hour?
- (ix) State Fick's first and second law of diffusion.

Q.3(a) What is lever rule? Explain this rule using phase equilibrium diagram in detail. Also calculate the number of degree of freedom for each case using Gibb's phase rule. [6]

Q.3(b) Sketch the Bridgman method for growth of crystals from melt and also describe its growth procedure in detail. [6]

OR

Q.3(b) Why Czochralski crystal growth technique is called pulling technique? Explain this crystal growth technique in detail using suitable diagram. [6]

Q.4(a) What is dislocation? Draw and explain different types of edge and screw dislocations produced in lattice. [6]

Q.4(b) How grain boundary, tilt boundary, twist boundary and twin boundary formed in crystalline lattice? Explain each of them in detail using necessary diagram. [6]

OR

Q.4(b) What is stacking faults? Describe stacking faults produced in hcp crystal (i) by removing closed packed plane and then shear, (ii) simply by shear plane and (iii) by inserting an extra plane. [6]

Q.5(a) Explain in detail the methods for production of colour centers. [6]

Q.5(b) What is dislocation? Using necessary diagram, explain velocity of dislocations and forces between dislocations. [6]

OR

Q.5(b) With help of suitable diagram describe decoration and surface methods to observe dislocation in crystalline solid. [6]

Q.6(a) What is Kirkendall effect? Explain the process of self-diffusion of radioactive sodium in sodium chloride crystal using necessary expressions. [6]

Q.6(b) Explain the brittle fracture and ductile fracture. Obtain the expression for the stress concentration factor (k). [6]

OR

Q.6(b) Discuss about the experimental method to determine the diffusivity in solids. [6]

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