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SEAT No._____ **No. of Printed Pages : 3**

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SARDAR PATEL UNIVERSITY

M.Sc. (Physics)(IVth Semester) Examination

Date : 17/04/2018, Day :Tuesday , Time :10:00a.m. to 1:00p.m.

Subject : Crystal growth and imperfections in Solids, Paper No. PS04EPHY02

CBCS(choice based credit system)

Important Note : Q.1 : Multiple choice questions (MCQ) carries one mark each.
Q.2 : Short questions carries two marks each (attempt any seven out of nine)
Q.3 to Q.6 : Long questions carries 12 marks .

Total Marks : 70

Choose the appropriate options from the following in Q.1 (8)

Q.1

i) Cross slip process occurs because of which type of defect
(a) edge dislocation (b) screw dislocation (c) point defects
(d) stacking faults

ii) If two parts of the crystal are rotated through a small angle,about an axis which is perpendicular to the grain boundary what type of boundary is formed
(a) tilt (b) twin (c) twist (d) none of these

iii) Which technique is used for the purification of the material ?
(a)float zone (b) flame fusion (c) Bridgman (d) Czochralski

iv) If there are four slip planes and three slip directions then how many slip systems are possible
(a) 9 (b) 24 (c) 12 (d) 6

v) Diffusion depends strongly on which of the following parameter
(a) time (b) temperature (c) pressure (d) atmosphere

vi) Kirkendall effect is observed in
(a) metals (b) alloys (c)semiconductors (d) superconductors

vii) If we want to grow crystals from gel, then pH of the solution should be
(a) less than 7 (b) greater than 7 (c) exactly 7 (d) none of these

viii) Three adjacent F centers forms :
(a) M-Center (b) R- center (c) V-center (d) F_A- center

(14)

Q.2 *Answer any seven questions out of nine in Q.2*

i) Define Burger's vector and Burger's circuit.

ii) Differentiate between edge and screw dislocation .

iii) Explain how Frank Read sources are helpful for studying growth of crystals.

iv) Draw the plots showing variation of stress with time that accounts for fatigue failures.

v) What are colour centers ? State the ways by which crystals can be coloured.

vi) How homogeneous nucleation differs from heterogeneous nucleation ?

vii) Define hardness and state the methods by which it can be determined.

viii) Draw cooling curve for binary and binary eutectic system and calculate number of degree of independent variables for each system.

ix) State Ficks first and second law of diffusion ?

Q.3(a) Describe Verneuil flame fusion technique for the growth of crystals from melt using necessary diagram. (6)

Q.3(b) Narrating different crystal growth techniques explain in detail Czochralski technique used for growth of industrially important crystals. (6)

OR

Q.3(b) With the help of suitable diagram, discuss in detail Peritectic phase equilibrium diagram. (6)

Q.4(a) What are stacking faults ? Explain stacking faults in fcc and hcp crystals. (6)

Q.4(b) Derive the expression for concentration of Frenkel defects in alkali halide crystals. (6)

OR

Q.4(b) Define slip planes and slip directions and solve the following problem : (6)
If 1eV energy is required to move an atom from the crystal's interior to the surface, then what is the proportion of vacancies present in the crystal at 1000^0K and 300^0K.

Q.5(a) Explain how electron microscope and field ion microscope can be used to observe defects in crystals. **(6)**

Q.5(b) Explain forces acting on dislocation and forces acting between dislocations in detail with appropriate diagrams. **(6)**

OR

Q.5(b) With suitable diagrams obtain the expression for stress field for edge and screw dislocations. **(6)**

Q.6(a) Explain different diffusion mechanisms by which migration of atoms can occur and also obtain the expression for nonsteady –state diffusion by considering semi-infinite solid. **(6)**

Q.6(b) If Boron is diffused into a thick slice of Silicon with no previous Boron in it at a temperature of 1100^0C for 2 hours. What is the depth below the surface at which the concentration is 10^{17}atoms/cm^3 if the surface concentration is 10^{18}atoms/cm^3 ? D(Boron into Silicon) = 4×10^{-13}cm^2/s at 1100^0C. **(6)**

Given :

erf Z	Z
0.8802	1.1
0.9000	X
0.9103	1.2

OR

Q.6(b) "The type of failure occurring in material due to static load for a very long period of time" Name the type of failure and justify the statement with proper diagrams. **(6)**