國立成功大學

114學年度碩士班招生考試試題

編　號：113

系　所：生物醫學工程學系

科　目：材料科學

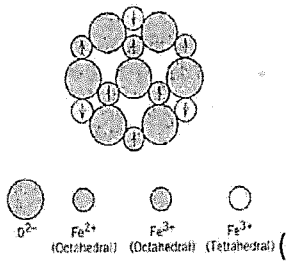
日　期：0210

節　次：第 2 節

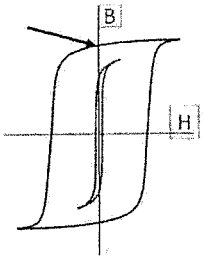
注　意：1.可使用計算機
2.請於答案卷(卡)作答，於試題上作答，不予計分。

I Multiple choice: (50 points, 1 point each)

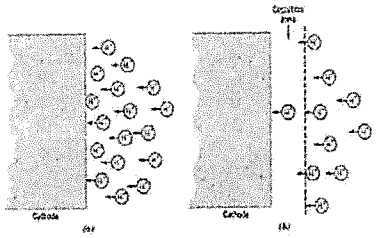
1. What Magnetic Responses in this figure? (Fig.1) (A)Diamagnetic (B) Paramagnetic (C) Ferromagnetic (D) Ferrimagnetic



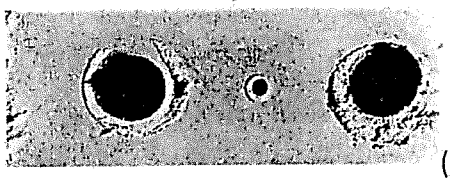
(Fig.1)

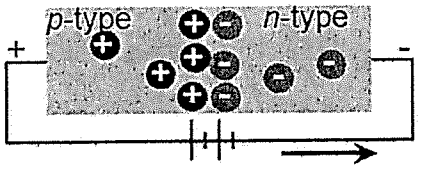


(Fig.2)


(Fig.3)

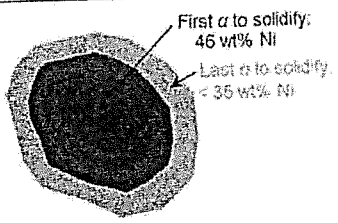
2. In Hysteresis and Permanent Magnetization, what' s the point the arrow indicates? (Fig.2) (A) Permittivity (B)Coercivity (C)Susceptibility (D)Remanence
3. What phenomenon can be explained in the right hand of this figure? (Fig.3) (A) Activation polarization (B)Concentration polarization (C) Electromotive force (D) Overvoltage
4. Which factor increase can decrease the resistivity of metal? (A) temperature (B) impurity (C) deformation (D) crystallinity
5. What is produce a unit rise in temperature for one mole of a material. (A)heat capacity (B)thermal expansion (C) thermal conductivity (D) thermal shock resistance
6. What kind of corrosion in this figure? (Fig.4) (A)Crevice (B) Erosion (C) Pitting (D) Intergranular


(Fig.4)

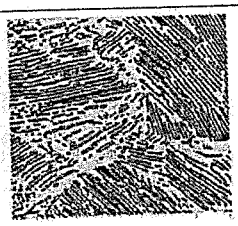


(Fig.5)

7. What's the phenomenon in this figure? (Fig.5) (A)Extrinsic drift (B) Rectifying junction (C) Junction transistor (D) MOSFET
8. What property is usually strong in fiber of composite? (A)Tension (B)Compression (C)Torsion (D) Shearing
9. Which steel is relatively week and ductile? (A) Stainless steel (B) low-carbon steel (C)medium-carbon steel (D) high-carbon steel
10. What's the common upper limit of carbon content for medium-carbon steel? (A) 0.25% (B) 0.4% (C) 0.6% (D) 1.40%
11. What is the main phase formed in cast iron different from steel? (A) Graphite (B)Pearlite (C)Ferrite (D)Cementite
12. Which two parameters are used to measure "Creep" (A)Stress vs time (B) Strain vs time (C)Stress vs strain (D) Strain vs number of cycle
13. Which method can increase fatigue life? (A) Increase mean stress (B) Applied tension on material (C)Surface roughness (D) Shot peening
14. What reason caused the concentration gradient in new phase formation? (Fig.6) (A)High heating rate (B)low heating rate (C)high cooling rate (D)low cooling rate

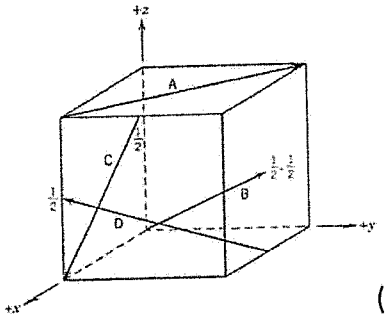


(Fig.6)



(Fig.7)

15. Name of this steel structure (Fig.7) (A)Austenite (B)Cementite (C)Ferrite (D)Pearlite
16. What's the **main reason** causing Plastic deformation of metal? (A) Dislocation density increase (B)Bond stretch (C)Bond rupture (D)Dislocation motion
17. Which mechanical property directly related to Critical Resolved Shear Stress (A)Yielding stress (B)Ultimate tensile strength (C)Young's modulus (D)Fracture stress
18. For FCC structure, which is slip plane? (A)(001) (B) (110) (C) (111) (D) (101)
19. What is the main reason for strain hardening from cold work (A) Grain size reduction (B) Grain boundary cancellation (C) Dislocation density increase (D)Lattice strain
20. The property can be recovered to prestressed state during annealing, which step is the most critical? (A) Recovery (B)Recrystallization (C) Strain harden (D) Temperature
21. What test is usually used to measure the tensile properties of ceramics materials? (A)Flexural (B)Tensile (C) Shear (D)Torsion
22. For metal, why the "fracture stress" is usually **lower than "tensile strength"**? (A)Necking (B)Crack (C) Dislocation (D) Loading rate
23. What is atomic migration in a pure metal (A) Interdiffusion (B) Self-diffusion(C) Interstitial diffusion (D) Vacancy diffusion
24. In diffusion mechanism, which factor usually will **not influence** the concentration of matter? (A)Charge (B) Time (C) Position (D) Temperature
25. In this force-interatomic separation curve, what is the physical characteristic of r_0? (A) radius of atom (B) binding energy of atom (C) balance of atom (D) diameter of atom
26. What type of material has the lowest stiffness? (A) Polymers (B) Ceramics (C) Metals (D) Composites
27. In the following unit cell, which vector represents the [121] direction (Fig 8)?



(Fig.8)

(Fig.9)

28. What kind of cast iron in this Fig.9? (A)Gray (B) White (C)Malleable (D)Ductile
29. Which of the following property usually will NOT increase with bonding energy of (A) melting point (B) conductivity (C) boiling point (D) tensile strength
30. What point defect in most "**unlikely**" happen in ceramic? (A) Cation interstitial (B)Anion interstitial (C) Cation vacancy (D)Anion vacancy

31. For a long carbon-carbon chain, what's the most possible angle between each bond (degree)? (A) 180 (B) 120 (C) 109 (D) 90
32. What method is used for crystal structure and interplanar spacing determinations? (A)AFM (B)SEM (C)Optical microscopy (D)X-ray diffraction
33. What's atomic packing factor for BCC? (A) 58melting% (B) 68% (C) 74% (D) 76%
34. What's the coordination number for the atom in HCP? (A) 4 (B) 6 (C) 8 (D) 12
35. Do noncrystalline materials have grain boundaries? Do noncrystalline materials display the phenomenon of allotropy (or polymorphism)? (A) Yes; Yes (B) Yes; No (C) No; Yes (D) No; No
36. Atoms of which of the following elements diffuse most rapidly in iron? (A) Mo (B) C (C) Cr (D) W
37. Why grain boundary can hinder the motion of dislocation by adjacent grains? (A) Atomic order (B) Grain size different (C) Dislocation increase (D)Different crystallographic direction
38. A system is at equilibrium, what is at a minimum? (A) Free energy (B) Surface tension (C) Entropy toughness
39. The most critical reason to decide the crystal structure in ceramics? (A)Defect type (B) Relative size between cation and anion (C)Molecular weight ratio (D)Crystal structure of pure metal
40. Deformation of semicrystalline polymer starts with? (A) Elongation of amorphous tie chain (B) Tilting of lamellar chain (C) Separation of crystalline block (D) Reorientation of block segment
41. Bone plate, the max receiving stress is 100 MPa, the yielding strength of material is 200 MPa, what is the **safety factor? (A) 0.5 (B) 1 (C) 2 (D) 4**
42. Which one is NOT the polymorphic form of carbon? (A)Fullerenes (B)Diamond (C) Graphite (D)Perovskite
43. A binary composition-temperature phase diagram for an "isomorphous system" will be composed regions of the following phase (A) L, α and β (B) L, L+α, α (C) L, L+α, L+βand β(D) L, L+α, L+βand β+α
44. Which of the following is the slip system for the face center cubic crystal structure? (A) {100} <110> (B) {110} <110> (C) {111} <110> (D) {110}<111> (E) {111} <100>
45. Which of the following method is usual way to strengthen the metal (A) by grain size increase (B) solid solution (C) hot working (D) dislocation removal
46. What' s the crystal structure of martensite (A) FCC (B) BCC (C) BCT (D) HCP (E) SC
47. Which of the following is not the advantage of Mg degradable biomaterial? (A)biodegradation (B)anti-inflammatory (C) high strength (D)antibacterial
48. What's the common upper limit of carbon content for low-carbon steel? (A) 0.1% (B) 0.25% (C) 0.6% (D) 1.4%
49. Which ceramic fabrication is in this Fig.10? (A)Slip casting (B)Blowing (C)Tape casting (D)Pressing
50. Which SFF method shown in this Fig.11? (A)Selected laser sintering (B)Stereolithography (C)Fused deposition medolling (D)Wax printing

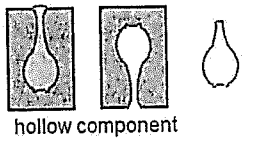


Fig.10

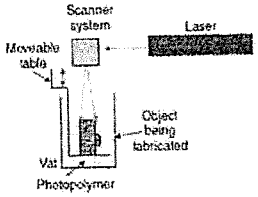


Fig. 11

II. Define the following terms: (1.5 pts each, 18 points total)

1. Burgers vector
2. Critical fiber length
3. Critical resolve shear stress
4. Dielectric constant
5. Ductile-to-brittle transition
6. FCC vs BCC for structure of material
7. Non-stoichiometry
8. Poisson's ratio
9. Peritectic reaction:
10. Plane strain fracture toughness (KIc).
11. Sacrificial anode
12. Spheroidizing

III. Essay and calculation

1. Within a cubic unit cell, **sketch the following directions**: (5 points)
   (a) $[\bar{1}10]$, (b) $[\bar{1}\bar{1}1]$, (c) $[\bar{1}22]$, (d) $[1\bar{2}\bar{3}]$, (e) $[1\bar{3}3]$,
2. What point defects are possible for MgO as an impurity in Al_2O_3? How many Ca^{2+} ions must be added to form each of these defects? (5 points)
3. A piece of corroded steel plate was found in a submerged ocean vessel. It was estimated that the original area of the plate was 100 cm^2 and that approximately 2.4 kg had corroded away during the submersion. Assuming a corrosion penetration rate of 12 mm/yr for this alloy in seawater, estimate the **time of submersion in years**. The density of steel is 7.9 g/cm^3. Use: **CPR=KW/ρAt**, where adjust constant uses 87.6 (5 pts)
4. A three-point transverse bending test is conducted on a cylindrical specimen of aluminum oxide having a reported flexural strength of 400 MPa. If the specimen radius is 2.4 mm and the support point separation distance is 30 mm, would you expect the specimen to fracture when a load of 600 N is applied? (5 points) where $\sigma = My/I$; $M=FL/4$; $I=\pi R4/4$
5. How the dislocations are formed in most materials? (4 points)
6. Please draw a classic stress-stain curve of a ductile metal under tension. Please define and point out on this curve for the following terms: (A)stress (include unit) (B)strain (include unit) (C)Young's modulus (include unit) (D)Yield stress (E)Ultimate tensile stress. (8 points)