國立成功大學 108 學年度碩士班招生考試試題

系　　所：材料科學及工程學系

考試科目：材料科學

考試日期：0223，節次：3

※ 考生請注意：本試題可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

材料科學共 50 題選擇題，每題答對得 2 分，答錯倒扣 0.5 分；滿分 100 分，倒扣至 0 分為止。

1. For FCC crystals, it would be much easier for the dynamic recovery to occur with

(a) small stacking fault energy　　(b) dislocations to do cross-slip

(c) high surface energy　　(d) small dislocation density

2. In grain growth, the relationship between the size of the grain(D) and time(t) is that D is proportional to

(a) $t^{-0.5}$　　(b) $t^{0.5}$　　(c) t^{-1}　　(d) t

3. For a cold-worked metal, which of the following parameters is not sensitive to the recrystallized grain size

(a) annealing temperature　(b) purity of the metal　(c) initial grain size　(d) amount of deformation

4. Secondary recrystallization results from

(a) surface energy　　(b) the strain energy of cold work　　(c) recovery　　(d) nucleation

5. Which of the following factors has less impact on the recrystallization of a cold worked metal?

(a) temperature　　(b) strain or degree of cold work　　(c) composition　　(d) the original grain size

6. Freezing can happen without change in composition or temperature at points that are called

(a) eutectoid　　(b) eutectic　　(c) congruent　　(d) peritectic　points

7. A reaction between a solid and a liquid that leads to the formation of a new and different solid phase is Called

(a) peritectic　　(b) eutectic　　(c) monotectic　　(d) peritectoid　　transformation

8. Which of the following statement about Hall-Petch equation is correct?

(a) conductivity　　(b) tensile ductility　　(c) tensile deformation resistance　　(d) formability

9. Which of the following statement about microsegregation is correct ?

(a) dendritic spacing　　(b) ingot center　　(c) rolling structure　　(d) recrystallization

10. Which of the following statement about microsegregation could be caused ?

(a) dislocations　　(b) stress concentration　　(c) solidification　　(d) heat-treatment

11. Which of the following statement is not support about the dominant factor of increasing hardness and strength of an oversaturated solid solution aluminum alloy pertaining to artificial aging

(a) diffusional phenomenon　(b) GP zone　(c) strain induced phenomenon　(d) precipitation hardening

12. Which of the following statement is support about the problem of DBTT
(a) superplasticity (b) tensile strength (c) tensile ductility (d) formability

13. Which of the following statement is support about PFZ
(a) precipitation free zone (b) precipitation focus zone (c) prestrain free zone (d) penetration free zone

14. Which of the following statement about GP zone is correct ?
(a) increasing strength (b) decreasing strength (c) causing brittleness (d) increasing conductivity

15. Mechanical twins (Deformation twins) generally occur in?
(a) Ni (b) Cu (c) Al (d) Mg

16. How to distinguish "Twinned Martensite" and "Deformation Martensite"?
(a) hardness of tempered (b) composition (c) coherent strain (d) resistivity

17. Characteristics of diffusionless transformation:
(a) coherent structure (b) 2D surface relief (c) bamboo leaf structure (d) amorphous material

18. T-T-T Diagrams, why the low-temperature transformation time is short?
(a) down hill (b) coherent interface (c) large strain (d) large driving force

19. In a hexagonal close-packed crystal structure, the angle between two direction of [-1 -1 2 0] and [-1 2 -1 0] on basal plane is
(a)30° (b) 45° (c) 60° (d) 120°

20. An x-ray diffraction pattern record of powder reveals the miller indices of (2 0 0), (2 2 0), (2 2 2), (3 1 0) and (4 0 0). What is the possible metal?
(a) molybdenum (b) silver (c) gold (d) cobalt

21. What is the c/a ratio of the HCP crystal structure < 1.63?
(a) Cobalt (b) zirconium (c) magnesium (d) zinc

22. Predict one of the following elements having a complete solubility in aluminum.
(a) Manganese (b) silicon (c) copper (d) zinc

23. Which one has the largest activation energy of self-diffusion?
(a) Nickel (b) copper (c) aluminum (d) molybdenum

24. Which one of defects is dominated in the self-diffusion?
(a) Dislocation (b) vacancy (c) grain boundary (d)phase boundary

25. Which one is the correct statement?
(a) Increasing the carbon concentration results in decreasing the diffusion coefficient D for carbon in fcc-Fe.
(b) Single crystal turbine blades are more creep resistant that polycrystalline turbine blades at high temperature.
(c) The diffusion coefficient D for carbon in fcc-Fe is larger than that in bcc-Fe.
(d) The diffusion coefficient D through the lattice > along the grain boundary > along the surface.

26. In general, the difference in atomic radii of a binary alloy with substitutional solid solution is less than about:
(a) ±5% (b) ±10% (c) ±15% (d) ±20%

27. A covalent compounds with the exact ratio of cations to anions as predicted by the chemical formula is called
(a) tetragonal (b) octahedral (c) neutrality (d) stoichiometry

28. One type of the defect involves a cation-vacancy and cation-iterstitial is called a
(a) Frenkel defect (b) Schottky defect (c) stacking fault (d) twin plane

29. For solid state transformations, the fraction of transformation F is a function of time t as follows: $F = 1-\exp(-kt^n)$ where k and n are time-dependent constants for the particular reaction. The above expression is often referred as the
(a) Fick's 2nd Law (b) Kirkendall effect (c) Avrami equation (d) Darken's equation

30. Which of the following transformations does not involve diffusion:
(a) precipitation transformation (b) martensitic transformation
(c) liquid to solid transformation (d) eutectoid transformation

31. For diffusion-controlled grain growth behavior, which of the followings best described the grain growth of high purity metal (where D is the diameter of the precipitate and t is the time):
(a) $D^3 \sim t$ (b) $D^2 \sim t$ (c) $D \sim t$ (d) $D^{1/2} \sim t$

32. A carbon steel is exposed in a $CO+CH_4$ gas mixture with a carbon activity (a_c) greater than 1. What kind of reaction may take place on the steel surface at high temperature?
(a) oxygenation (b) sulfication (c) nitridation (d) carburization

33. The extent and magnitude of anisotropic effects in crystalline materials are functions of ?
(a) structural symmetry (b) atomic number (c) Miller indices (d) Energy level

34. What is the atomic packing number of FCC?
(a) 0.68 (b) 0.56 (c) 0.78 (d) 0.74

35. What is the definition of linear density (LD)?
(a) the radius of atoms per unit length (b) the number of atoms per unit length
(c) the number of atoms per unit area (d) the weight of atoms per unit volume

36. What kind of structure with the atomic coordinates of (0, 0, 0) and (1/2, 1/2, 1/2)?
(a) FCC (b) HCP (c) BCC (d) SC

37. For Hexagonal crystals, the conversion from the three-index system to the four-index system is based on, $[u'v'w'] \rightarrow [uvtw]$. Define t.
(a) $-(u+v)$ (b) $-(u'+v')$ (c) w' (d) $u'+v'$

38. What is the definition of planar density (PD)?
(a) the number of atoms per unit volume that are centered on a plane
(b) the density of atoms
(c) the volume of atoms that are centered on a plane
(d) the number of atoms per unit area that are centered on a plane

39. The diffractometer is used to determine the ____ at which diffraction occurs for powdered specimens.
(a) crystals (b) angles (c) diameters (d) none of them

40. Which of the following methods are commonly used to produce long lengths of metal sheet?
(a) cold rolling (b) hot rolling
(c) hot rolling followed by cold rolling (d) hot rolling followed by extrusion

41. The yield strength is chosen when
(a) 0.1% (b) 0.2% (c) 0.3% (d) 0.4%
plastic strain has taken place.

42. The ultimate tensile strength is the maximum strength reached in the engineering stress-strain curve. The more engineering stress decrease before fracture indicates this material has
(a) high ductility (b) high creep (c) high elasticity (d) high hardness

43. When a metal is heavily cold worked, to increase its ductility, metal needs to be heated to a temperature that is
(a) just below its melting temperature
(b) just above its melting temperature
(c) just above the recrystallization temperature range
(d) just below the recrystallization temperature range

44. Fatigue limit of a metal is usually determined by measuring maximum stress of a material that can withstand under repeated load in the range of
(a) 25-30% of UTS (b) 50-70% of UTS (c) 40-60% of YS (d) 60-80% of YS

45. Which of the following polymers are biodegradable?
(a) PLA (b) PGA (c) Cellulos (d) all of the above

46. Which one of the following is the eutectic reaction? C_E is the eutectic composition. L is the liquid phase.
(a) $L(C_E) \rightarrow \alpha(C_{\alpha E}) + \beta(C_{\beta E})$ (b) $L(C_E) \rightarrow \gamma(C_{\gamma E}) + L(C_E)$
(c) $L(C_E) \rightarrow \alpha(C_{\alpha E})$ (d) $L(C_E) \rightarrow \beta(C_{\beta E}) + L(C_E)$

47. Which one of the following phases is formed by diffusionless transformation?
(a) Pearlite (b) Martensite (c) Bainite (d) Austenite

48. What is the material most commonly used for optical fiber?
(a) Silica (b) Carbon (c) As (d) Ge

49. Which one of the following can form the carbon nanotubes structure?
(a) heptagon carbon + hexagon carbon (b) hexagon carbon
(c) pentagon carbon + heptagon carbon (d) pentagon carbon + hexagon carbon

50. Which one of following is Not a ceramic material?
(a) Limestone (b) Soda ash (c) Alumina (d) Germanium