國立中央大學 109 學年度碩士班考試入學試題

所別： 機械工程學系 碩士班 製造與材料組(一般生)　　　共 6 頁　第 1 頁

科目： 材料科學(金屬材料)

本科考試可使用計算器，廠牌、功能不拘　　　　　　　　＊請在答案卷(卡)內作答
共計 40 題，每題答對得 2.5 分，答錯倒扣 0.5 分，未答不計分。

1. Which one of parameters can characterize the status of electrons in an atom? (A) the lattice constant of metal crystals (B) quantum numbers (C) peak location of x-ray diffraction (D) all of the above (E) none of the above.

2. If the dislocation in metal is hard to move, the metal may be (A) softer (B) weaker (C) deformable (D) fragile (E) dense.

3. Interstitial diffusion in solid involves the creation of (a) vacancy (b) dislocation (c) grain boundary (d) nanoparticle (e) none of the above.

4. Which one of processes can improve the fatigue performance of a metallic material? (a) carburizing (b) shot peening (c) nitriding (d) all of the above (e) none of the above.

5. In a body-centered cubic crystal, which listing plane has the same atom arrangement as the (101) plane?　(a) (110) (b) (100) (c) (111) (d) (001) (e) (010).

6. What is a so-called linear defect in a crystalline solid? (a) grain boundary (b) vacancy (c) dislocation (d) micro-segregation (e) all of the above.

7. Which one of statements is correct? (A) interstitial diffusion is normally slower than vacancy diffusion, (B) interstitial atoms are less mobile (C) the interdiffusion of copper in nickel is the type of interstitial diffusion (D) the interdiffusion of carbon in iron is the type of interstitial diffusion (E) None of the above.

8. The solid which has the completely isotropic property is in (A) amorphous structure (B) martensite structure, (C) FCC structure, (D) polycrystalline structure, (E) all of the above.

9. In a metallic solid, atoms can be held together by (A) the attraction between the atomic cores, (B) electron share between adjacent pairs of atoms, (C) the attraction between atomic cores and the electrons, (D) hydrogen bonds, (E) all of the above.

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10. According to which law, X-ray diffraction has the ability to detect crystal structure? (A) Maxwell's law of optic-electron (B) Einstein's law of refraction (C) Bragg's law (D) Bohr's law of atoms (E) total reflective law.

11. The number of atoms per unit cell in the body-centered cubic (BCC) structure is (A) 2 (B) 4 (C) 6 (D) 8 (E) 10.

12. In a solid material, which one of the processing needs the existence of vacancies? (A) deformation twinning (B) cross-slip (C) self-diffusion (D) cold work (E) recrystallization.

13. Steady-State Diffusion (A) rate of diffusion independent of time (B) flux proportional to concentration gradient (C) rate of diffusion independent of temperature (D) flux proportional to a location (E) none of the above.

14. Which comparison in the total number of slip systems between the two crystals is correct? (A) HCP > BCC (B) HCP > FCC (C) FCC > BCC (D) BCC > HCP (E) none of the above.

15. Which one of factors can change the activation energy of diffusion in solid? (A) temperature (B) diffusivity (C) diffusing species (D) concentration (E) location.

16. Which one of the following comparison of Atomic Packing Factor (APF) of two crystal systems is correct? (A) simple cubic > body-centered cubic (B) hexagonal close-packed > face-centered cubic (C) body-centered cubic > hexagonal close-packed (D) diamond cubic > simple cubic (E) body-centered cubic > diamond cubic.

17. Resilience is the ability of a material to (A) store energy in the plastic deformation region (B) break a unit volume of itself (C) release energy form the plastic deformation region (D) release energy in the toughness (E) store energy in the elastic region.

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18. Which statement is correct for the description of deformation? (A) for elastic, it is time-independent and non-permanent (B) for elastic, it is time-dependent and permanent, (C) for elastic it is time-independent and permanent, (D) for elastic, it is time-dependent and non-permanent (E) all of the above.

19. Which process may not increase material strength? (A) utilizing solid solutions (B) promoting precipitation (C) increasing grain size (D) performing cold work (E) reducing self-diffusion.

20. In a solid, if two atoms are separated in equilibrium, then (A) the potential energy of the solid is the minimum. (B) the potential energy of the solid is the maximum. (C) the potential energy of the solid is the average. (D) the potential energy of the solid is undecided. (E) all of the above.

21. Vacancies play an important role in (A) deformation twinning, (B), cross-slip, (C) self-diffusion, (D), cold work, (E) re-crystallization.

22. Which is the type of dislocation belonging to among the defects in a crystal material: (A) point, (B) line, (C) boundary, (D) surface, (E) volume

23. Which material in the following can be strain-hardened after its plastic deformation at room temperature: (A) lead (Pb), (B) tin (Sn), (C) corundum (aluminum oxide), (D) steel (Fe), (E) polyethylene (PE).

24. Recrystallization is (A) used to increase the strength of the material, (B) classified as one of the stages in the process of cold work, (C) useful to increase the ductility, (D) to increase the density of dislocation, (E) on the purpose for grain growth.

25. Which material shows anisotropic property: (A) amorphous carbon, (B) Si, (C) Graphite, (D) Cu, (E) Ge.

26. Refer to the following the phase diagram of iron-carbon alloy, What is the eutectic point? (A) B (B) D (C) G (D) H (E) K?
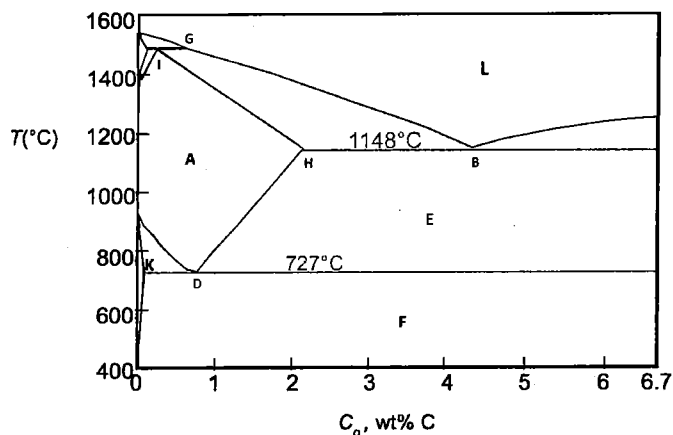
參考用

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27. Which of the following technology is able to observe the distribution of vacancy and dislocations in a crystal materials: (A) optical microscopy, (B) Transmission Electron Microscopy(TEM), (C) Scanning Electron Microscopy(SEM), (D) X-ray diffraction(XRD), (E) None of the above.

28. For the precipitation hardening heat treatment, what microstructure will NOT be produced after precipitation? (A)Equilibrium supersaturation phase, (B)Meta-stable phase, (C)Supersaturation phase, (D)Equilibrium phase, (E) None of the above.

29. Which one is the main plastic deformation mechanisms of metals at low temperature? (A)Slip and creep, (B) Slip and twin deformation, (C) Creep and Grain boundary Sliding, (D) Slip and Grain boundary Sliding, (E) Twin deformation and Grain boundary Sliding.

30. For the steel, a measurement of the ability to form martensite is: (A)Tensile test, (B)Hardness test,　(C)Creep test, (D)Hardenability test, (E)Fatigue test.

31. In a corrosive environment, which statement below is wrong: (A)Cold-worked metals are more susceptible to corrosion than noncold-worked, (B)Fe is more active than Au, (C)A small anode-to-cathode area ratio is good design, (D)For a metal corrosion process, metal acts as anode; oxygen or water acts as cathode,(E)None of above.

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32. Which of the following processes can NOT be applied to improve the fatigue performance of a metallic component? (A)Induce residual compressive stress, (B)Nitriding (C)Shot peenig, (D)Carburizing,　(E)Induce residual tensile stress.

33. Which is NOT the characterization of refractory metals? (A)High melting temperature, (B)Large elastic moduli, (C)High strength and hardness at ambient, (D)Low strength and hardness at elevated temperature, (E) Strong Interatomic bonding.

34. In general, which of the following crystal structures of metal is the most ductile? (A) BCC, (B) Teragonal, (C) FCC, (D) HCP, (E) None of the above.

35. Comparing the electrical conductivity of a crystalline metal and its noncrystalline counterpart, which one has higher resistivity?(A) crystalline one; (B) noncrystalline one; (C) unable to measure; (D) similar value; (E) none of the above.

36. What is the crystal structure of ferrite? (A) SC (B) BCC (C) FCC (D) HCP (E) Diamond.

37. What is the composition of pearlite? (A) Fe_2O_3 + ferrite (B) Fe_3C + austenite (C) FeO_2 + austenite (D) SiC + ferrite (E) Fe_3C + ferrite

- Using the following isothermal transformation diagram for a 0.45 wt% C steel alloy, determine the final microstructure of a small specimen that has been subjected to the following time-temperature treatments. In each case that the specimen begins at 850°C and that it has been held at this temperature long enough to have achieved a complete and homogeneous austenitic structure. Answering the questions (38) - (40):

參考用

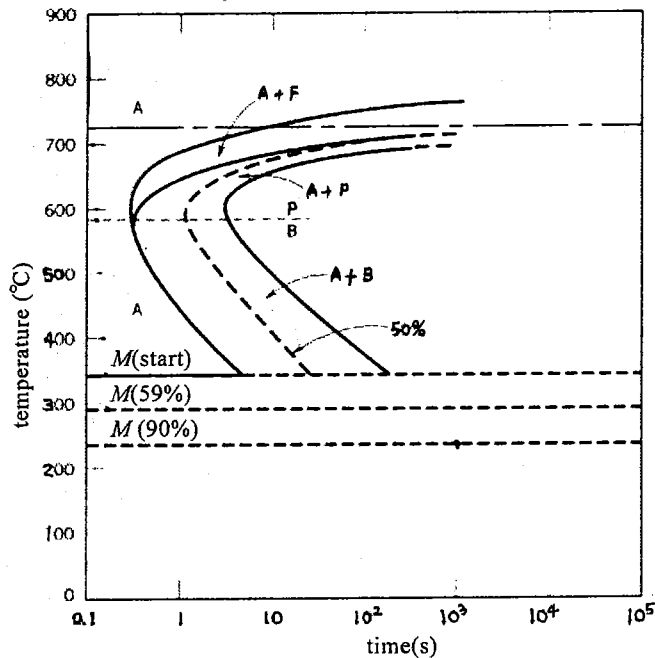注意：背面有試題

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A: austenite; B, bainite; F, proeutectoid ferrite; M, martensite; P, pearlite.

38. Rapidly cool to 250°C, hold for 1,000 s, then quench to room temperature. The final microstructure consists of (A) 80% martensite and 20% austenite (B) 80% martensite and 20% pearlite (C) 100% martensite (D) 80% austenite and 20% pearlite (E) 20% austenite and 80% pearlite.

39. Rapidly cool to 700°C, hold for 25 s, then quench to room temperature. The final microstructure consists of (A) martensite and pearlite (B) martensite and proeutectoid ferrite (C) martensite and bainite (D) austenite and pearlite (E) austenite and proeutectoid ferrite.

40. Rapidly cool to 650°C, hold at this temperature for 3 s, rapidly cool to 398°C, hold for 10 s, then quench to room temperature. The final microstructure consists of (A) ferrite and pearlite (B) bainite and martensite (C) ferrite and bainite (D) ferrite, pearlite and bainite (E) ferrite, bainite, martensite, and pearlite