

大同大學 97 學年度研究所碩士班入學考試試題

考試科目：物理冶金

所別：材料工程研究所

第 1/2 頁

註：本次考試 不可以參考自己的書籍及筆記； 不可以使用字典； 不可以使用計算器。

1. Explain the following terms: (30%)

- (a) critical resolved shear stress
- (b) anisotropy
- (c) planes of a zone
- (d) intergranular fracture
- (e) fatigue
- (f) tempering
- (g) Gibbs phase rule
- (h) Kirkendall effect
- (i) GP zone
- (j) strain aging

2. (a) Determine the Miller indices for plane ABC in Fig.1 of a tetragonal unit cell.

The lattice parameter of the unit cell is a , a , and c . $OA = \frac{a}{2}$, $OB = \frac{3a}{4}$, and $OC = \frac{c}{3}$ (2%)

(b) Determine the Miller indices for direction mn in Fig.1. (2%)

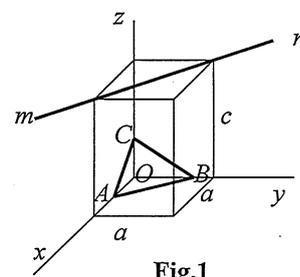


Fig.1

3. Consider a typical stress-strain curve shown in Fig.2 for a face-centered cubic single crystalline metal. Briefly explain the reasons for the different slopes observed in the curve. (5%)

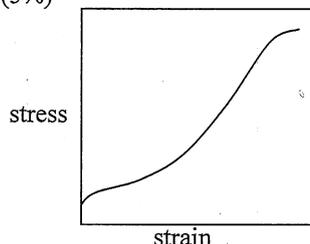


Fig.2

4. What is the reason for the formation of thermal grooves on the solid surfaces? (3%)

5. Briefly explain why the strain energy is reduced after the formation of low-angle boundaries during recovery in the annealing of a cold-worked metal. (4%)

6. Briefly describe the effect of grain boundary on the mechanical strength of metals. (4%)

7. Consider that vacancies are created by movements of atoms from positions inside the crystal to positions on the surface of the crystal, as shown in Fig.3. The internal energy is increased due to the decrease in the number of bonds. What is the reason for the existence of an equilibrium concentration of vacancies? (5%)

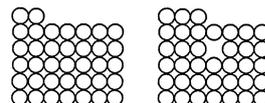


Fig.3

8. If the grain growth rate of a polycrystalline solid is reduced when a small amount of solute is added, what is the possible reason? (5%)

9. Describe the Griffith criterion for the expansion of a crack. (5%)

〈背面繼續〉

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第 2/2 頁

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10. The hardenability of a steel is a function of its chemical composition and the size of the austenite grains. An important factor in determining the required hardenability is the speed of quench. What are the advantages and disadvantages (limitations) of using a steel of high hardenability? (5 %)
11. What is homogenizing anneal of an ingot? What is (are) its purpose(s)? (5%)
12. For a precipitation-hardened alloy, please answer the followings:
 - (a) Describe the procedures of heat treatments to achieve the precipitation hardening effects.
 - (b) Schematically plot the hardness variation with the aging time and mark the points of peak aging and overaging.
 - (c) Describe the microstructural changes of the precipitates when the alloy goes from peak aging to overaging. (15%)
13. Fig.4 is a part of Fe-C phase diagram.
 - (a) Copy the figure on your answering sheet first and mark (on your drawing) all the points where three-phase reactions occur.
 - (b) Identify and write down the phase reactions of the points in (a).
 - (c) Estimate the weight ratio of ferrite and cementite in pearlitic steel ($C = 0.77\%$) at room temperature. (10%)

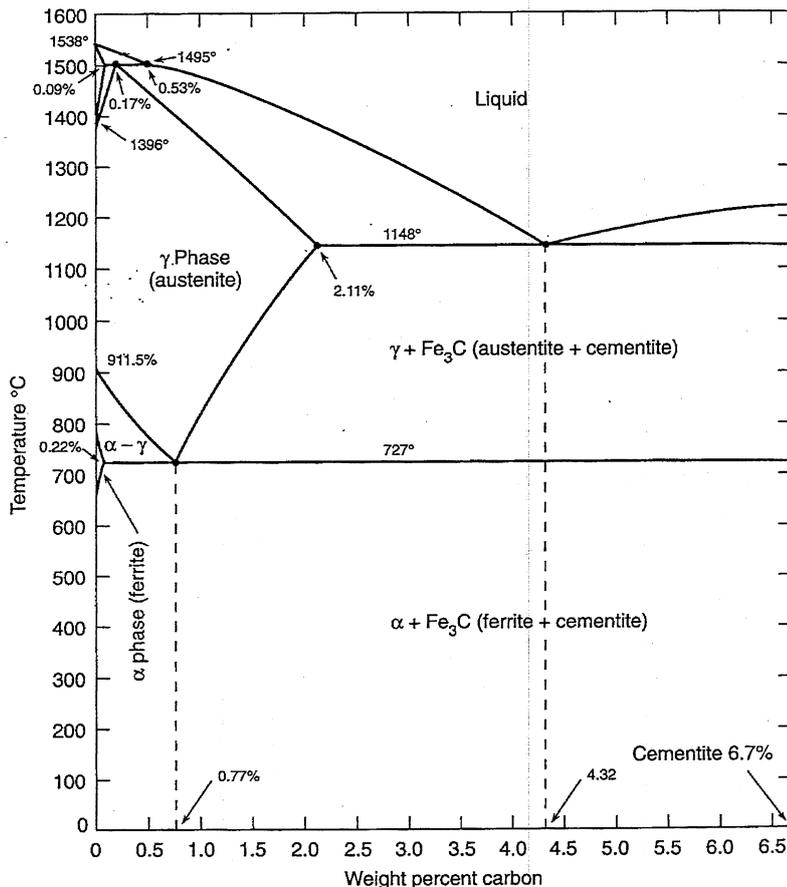


Fig.4 Phase diagram of Fe-C (part)