

1. About dislocation (10%)
 - (1) Why are dislocations defined as linear defects?
 - (2) Why can dislocation theory explain the fact that the real strength of metal is significantly lower than its theoretical strength?
2. For the FCC crystal structure (10%)
 - (1) Calculate its atomic packing factor.
 - (2) Within a FCC unit cell, sketch $(11\bar{1})$ and $[10\bar{2}]$, respectively.
3. What is the driving force and activation energy for the reaction shown in Figure 1? (5%)

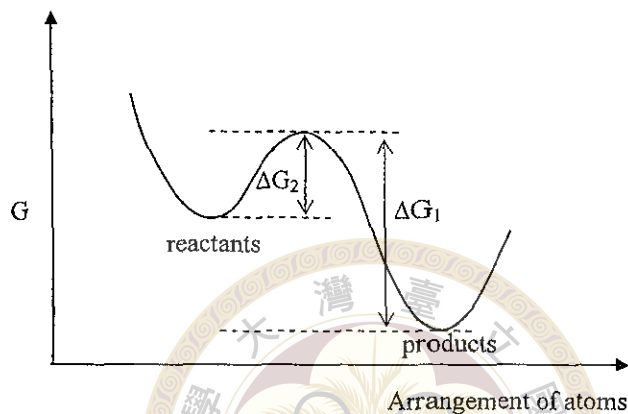


Figure 1

4. For tensile engineering stress-strain and true stress-strain curves, show that (5%)
 $\sigma_T = \sigma(1 + \epsilon)$ and $\epsilon_T = \ln(1 + \epsilon)$
 Where σ and ϵ are engineering stress and strain, respectively; σ_T and ϵ_T are true stress and strain, respectively.
5. Consider a single crystal of silver oriented such that a tensile stress is applied along a $[001]$ direction. If slip occurs on a (111) plane in a $[\bar{1}01]$ direction, and is initiated at an applied tensile stress of 1.2 MPa, compute the critical resolved shear stress. (5%)
6. Compare and contrast the characteristics of fracture surfaces of a ductile metal after tensile and fatigue tests, respectively. (5%)
7. Outline a heat treatment procedure to improve the strength and toughness of low-carbon steel. And, briefly explain the purpose of each treatment involved in this procedure. (10%)

見背面

8. Figure 2 shows the phase diagram of Sn-Bi binary alloy. (10%)
- (1) Briefly explain the microstructural evolution when an Sn-30wt%Bi alloy is slowly cooled from 300°C to room temperature.
 - (2) Calculate the mass fraction of eutectic β in this alloy at room temperature.

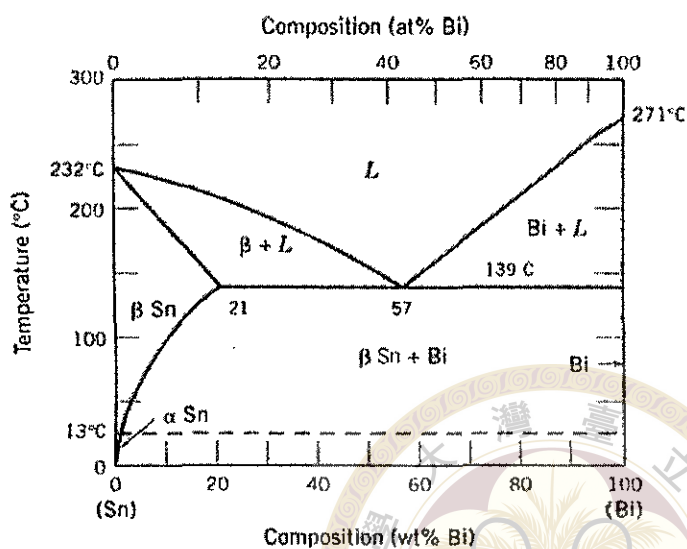


Figure 2

9. Would you expect Frenkel defects for anions to exist in ionic ceramics in relatively large concentrations? Why or why not? (5%)
10. What is (are) the advantage(s) to employ fine powders for the fabrication and processing of clay products? (5%)
11. High-density polyethylene may be chlorinated by inducing the random substitution of chlorine atoms for hydrogen. (10%)
 - (1) Determine the concentration of Cl (in wt%) that must be added if this substitution occurs for 5% of all the original hydrogen atoms.
 - (2) In what ways does this chlorinated polyethylene differ from polyvinyl chloride?
12. The realization of the Boeing 777 wide-body twin-engine airliner utilizes several strategies to reduce the weight of the aircraft. Can you comment on how to reduce the weight of the aircraft from the point of view of materials science and engineering? (10%)
13. Briefly discuss the factors influencing the conductivity of a semiconducting material. (5%)
14. Briefly explain why mugs are generally made of ceramic materials. (5%)

試題隨卷繳回