

國立臺灣科技大學

九十四學年度碩士班招生考試試題

系所組別：高分子工程系碩士班丁組

科目：材料科學

1. 總分 100 分

2. 選擇題務必於答案卷內依序作答，否則不予計分

1. Given that the coefficient of expansion for Al is $25 \times 10^{-6} \text{ } ^\circ\text{C}^{-1}$ and that for SiC is $4.3 \times 10^{-6} \text{ } ^\circ\text{C}^{-1}$, predict which material has the higher melting temperature. Why? (5%)
2. What are the planes of highest density in FCC and BCC? What are the directions of highest density within these planes? (5%)
3. Why are FCC metals more ductile than BCC metals? (5%)
4. Discuss the differences between edge and screw dislocations? (5%)
5. List the dominant charge carrier(s) in each of the following semiconductors? (10%)
 - A. Intrinsic GaAs
 - B. Si doped with P (at low temperatures)
 - C. Ge doped with P (at high temperatures)
 - D. GaAs doped with Zn (at low temperatures)
 - E. CdTe doped with anything (at high temperatures)
6. An n-type semiconductor is known to have an electron concentration of $3 \times 10^{18} \text{ m}^{-3}$. If the electron drift velocity is 100 m/s in an electric field of 500 V/m, calculate the conductivity of this material. (10%)
7. What is the difference between atomic structure and crystal structure? (10%)
8. Calculate the number of vacancies per cubic meter in gold at 900°C . The energy of vacancy formation is 0.98 eV/atom; the atomic weight and density for Au are 196.9 g/mol and 19.32 g/cm^3 , respectively. (10%)

hint:

Boltzmann's constant $k = 1.38 \times 10^{-23} \text{ J/atom-K} = 8.62 \times 10^{-5} \text{ eV/atom-K}$

Avogadro's number $N_A = 6.023 \times 10^{23} \text{ atoms/mol}$.
9. (a) Compare interstitial and vacancy atomic mechanisms for diffusion. (b) Briefly explain why interstitial diffusion is normally more rapid than vacancy diffusion. (10%)
10. Please describe the characteristics of free energy vs. composition curve for the binary solid solution. (14%)

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11. 選擇題（每題 2 分，答錯倒扣 0.5 分，倒扣至本大題零分為止）

- (1) Fick 第一定律描述穩定態(steady state)擴散的特徵，即濃度不隨下列何者變化？
(A) 時間 (B) 距離 (C) 溫度 (D) 體積
- (2) 下列何者為面心立方(FCC)晶體的孿晶面(Twinning plane)？
(A) {112} (B) {110} (C) {111} (D) {100}
- (3) 理想 HCP (hexagonal close-packed) 晶格，其 c 軸與 a 軸長之比值約為
(A) 1.88 (B) 1.63 (C) 1.59 (D) 1.56
- (4) 結晶固體中之刃狀轉位(edge dislocation)為晶體之何種缺陷？
(A) 點 (B) 線 (C) 面 (D) 體
- (5) 從高分子的重複結構單元(repeat unit)對稱性可知，下列何者最易結晶化(crystallization)？
(A) polyethylene (B) polypropylene (C) polystyrene (D) polyvinyl chloride
- (6) 材料中能發生擴散的根本原因為何？
(A) temperature change (B) concentration gradient
(C) mass change (D) chemical potential gradient
- (7) 下列何種儀器不能測得材料結晶化度？
(A) Differential scanning calorimeter (B) X-ray diffraction
(C) Infrared spectrometer (D) Mass spectrometer
- (8) 兩種物質若要混合均勻，混合後之自由能要比混合前
(A) 不變 (B) 增加 (C) 減少 (D) 相容性與自由能變化無關

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