

八十六學年度材料科學工程研究所(系) 甲二 組碩士班研究生入學考試

物理冶金(I)

科號 1801 共 3 頁第 1 頁 *請在試卷【答案卷】內作答

科目

1. 利用硬球模型說明簡單立方體、體心立方體及面心立方體三種晶體之原子配位數與空間堆積密度。(5%)
2. 何謂晶體之米勒指數值(Miller indices)? 並請證明一 (hkl) 平面與 $[hkl]$ 方向在立方體中是相互垂直。(5%)
3. 何謂布拉格定律 (Bragg's law)? 請同時證明在面心立方晶體中不會有 (100) 面繞射。(5%)
4. 請說明金屬鍵與共價鍵之原理與異同。(5%)
5. 請利用物質波與能峯井 (energy well) 觀念, 解釋金屬中之電子能量是量子化的。(5%)
6. 為何半導體之能帶結構中會出現分離之價電帶 (conduction band) 與導電帶? 若在其中加入不同價電子之異質原子會出現什麼狀況?(5%)
7. 請解釋溫度對金屬與半導體電阻係數之不同。(5%)
8. 何謂差排之卜格向量 (Burger's vector)? 此向量在刃差排 (edge dislocation) 與螺旋差排 (screw dislocation) 上有何不同?(5%)
9. 晶界的三個自由度為何?(5%)
10. 請說明各種退火 (annealing) 機構及其驅動力來源。(5%)

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11. A Kirkendall-type experiment was performed in the A-B alloy system. Markers placed at the original interface were found to move with the isoconcentration front, $N_A = 0.45$. After a 50-hour anneal the following data were obtained:

Concentration gradient at $N_A = 0.45$, $\partial N_A / \partial x = 3 \text{ cm}^{-1}$

Self diffusion coefficient of A, $D_A^{self} = 2.0 \times 10^{-8} \text{ cm}^2 \text{ s}^{-1}$

Self diffusion coefficient of B, $D_B^{self} = 1.5 \times 10^{-8} \text{ cm}^2 \text{ s}^{-1}$

(a) Assume that A and B form regular solutions, i.e., the enthalpy of mixing $\Delta H = \Omega N_A N_B$, where $\Omega = -0.5RT$. State your assumptions.

(i) Calculate the marker displacement relative to the end of A-rich. (5%)

(ii) Calculate the Matano interface displacement relative to the end of A-rich. (5%)

(iii) Calculate the Matano interface displacement relative to the marker. (5%)

(b) Suppose now that the marker displacement of part (a) were zero due to porosity.

(i) Calculate the pore volume per unit cross sectional area at $t=50$ hours. (5%)

(ii) In which part of the specimen do you expect the pores to form? (5%)

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12. Please answer the following questions using phase diagram of Ag-Cu given below.
- Draw free energy versus concentration curves at $T=1000, 850, 779$ and 600°C . (5%)
 - Draw the variation of \bar{G}_{Cu} with composition across the phase diagram at 600°C . (5%)
 - Draw a Ag-Cu diffusion couple annealed for a short time at 600°C , and explain it briefly. (5%)
 - Draw microstructures of (i) 15 wt% Cu-85 wt% Ag, (ii) 28 wt% Cu-72 wt% Ag and (iii) 85 wt% Cu-15 wt% Ag when cooled down slowly from elevated temperature. (5%)
 - Calculate the amount of α , β and eutectic phases in part (d). (5%)

