元智大學 103 學年度研究所 碩士班 招生試題卷

系(所)別：化學工程與材料科學學系碩士班　組別：不分組-選考B　科目：物理冶金　用紙第 1 頁共 1 頁

●可使用現行『國家考試電子計算器規格標準』規定第二類之計算機

1. True/False? (true: T; false: F) (10%)

( ) (a) Substitutional diffusion occurs when the diffusing atom is small enough to move between the atoms in the lattice. This type of diffusion requires no vacancy defects in order to operate.

( ) (b) The occurrence of heterogeneous nucleation is more difficult than that of homogeneous type.

( ) (c) A peritectic reaction is a reaction where a solid phase and liquid phase will together form two different solid phases at a particular temperature and composition.

( ) (d) Tetragonal crystals have a lattice parameter of $a = b \neq c$ and $\alpha = \beta = \gamma = 90°$.

( ) (e) The driving force for chemical diffusion is chemical potential gradient.

2. Describe the following nouns (請詳細說明物理現象，非考英翻中): (30%)

(a) Recrystallization; (b) Skew dislocation; (c) Martenstic transformation; (d) Supercooling; (e) Stacking fault; (f) Kirkendall effect. 每小題5%

3. (a)Derive Fick's second law via Fick's first law, $J = -D(\partial C/\partial x)$ (J is atomic flux; D is diffusivity). (10%)

(b)Use Fick's second law to determine which line/lines shown in Fig. 1 had already reached steady state. (5%)

(c)Use the Gibbs free energy and chemical potential correlation to explain why "up-hill" diffusion occurred in solids. (10%)

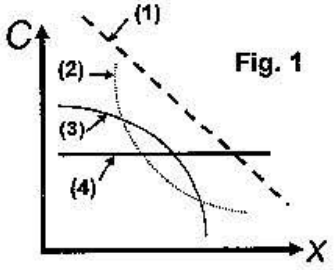

Fig. 1

4. Gibbs phase rule describes the possible number of degrees of freedom F in a closed system at equilibrium, in terms of the number of phases P and the number of chemical constituents C in the system.

(a) Please derive the phase rule, $F = C - P + 2$. (5%)

(b) Find the F value (= 0, 1, 2, or 4) for a quaternary system at 273 K, 3 atm. (3%)

(c) Show the F values (= 0, 1, 2, 3, or 4) in the phase field ①-④ of Fig. 2. (4%)

(d) Draw the microstructural evolutions in detail for the solidification of alloy 1 to 2 (see Fig. 2) from liquid to 100 °C (Hint: equilibrium cooling). (8%)

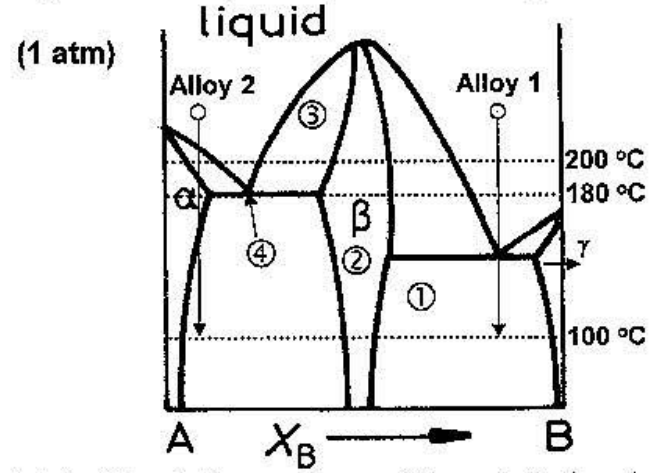

Fig. 2

5. Provide detailed descriptions on the possible analytical methods to determine:

(a) Chemical compositions of phases (5%)

(b) Crystal structures of phases (5%)

(c) Crystallographic orientation/texture (5%)