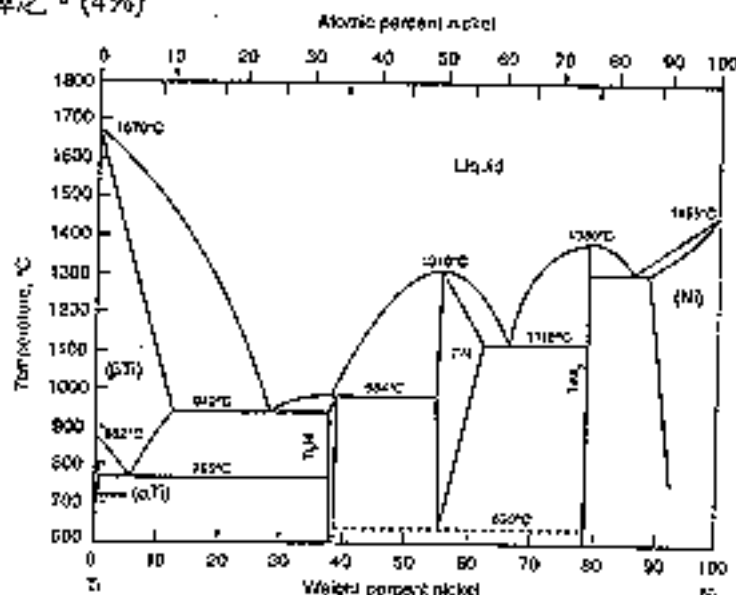


請務必依題目順序作答

- It has been estimated that the enthalpy for the formation of self-interstitial atoms in copper is about 385,000 J/mole. The gas constant $R = 8.314 \text{ J/mole.K}$.
 - Please derive the equation of equilibrium concentration of self-interstitial atoms. (4%)
 - 如果一塊銅自 1000 K 淬火(quench)至 300K, 請問其 concentration of self-interstitial in Cu 爲何? (3%)
 - What is the mean distance between self-interstitial in Cu at 1000 K. (3%)

2. 下圖爲 Ti-Ni 二元相圖。

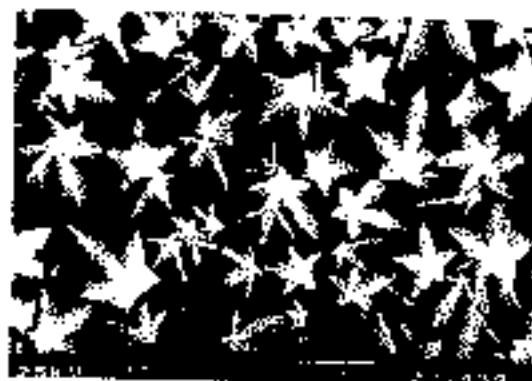
- 請列出所有共晶(eutectic)、共析(eutectoid)、包晶(peritectic)、包析(peritectoid) 型式之反應式, 註明其反應相、反應溫度、各相之成分(Ni 原子%)。(6%)
- 請敘述 Ti-Ni(20%wt)合金自 1600 °C 緩慢冷卻至 900 °C 時, 其可能之金相爲何? 並解釋之。(4%)



- What is Pick's first and second laws of diffusion? Explain their variables and assumptions. (4%)
 - Please describe the difference between inter-diffusivity and self-diffusivity. (4%)
 - What is Kirkendall effect? 請解釋其物理現象。(4%)
- Please describe the mechanisms of dendrite formation in a pure metal and in an alloy respectively. (4%)
 - What is Scheil Equation? Why it is also called non-equilibrium level rule. (4%)
- 請敘述何謂 Martensitic transformation? 並討論其特性? (5%)
 - 何謂形狀記憶合金 (Shape Memory Alloy)? 並討論其特性? (5%)

(背面仍有題目, 請繼續作答)

6. (a) Prove that there is no 5-fold ($360^\circ/5$) rotation axis in crystal symmetry. (5%)



- (b) The crystals shown in the right are Ti(CN) formed by chemical vapor deposition. Since there exists no 5-fold rotational symmetry, why are the crystals pentagonal (五角狀)? (5%)

7. (a) Plot the curve of lattice potential energy vs. interatomic spacing for a given isotropic crystal. Explain how this curve is obtained. (4%)
- (b) Use the result of (a) to deduce theoretical fracture stress of the crystal, σ_{th} , in another plot which shows the curve of cohesive force per unit area vs. interatomic spacing. (4%)
- (c) If fracture of the crystal occurs by intercrystalline separation without plastic deformation, prove that $\sigma_{th} \cong (\gamma E/a_0)^{1/2}$, where γ , E and a_0 are the surface energy, Young's modulus and equilibrium interatomic spacing, respectively. (8%)
- (d) The fracture stress of a brittle crystal, σ , is practically smaller than its σ_{th} . Please estimate the ratio of σ/σ_{th} and explain how your estimation is made. (4%)
8. Large-angle grain boundaries are usually low in mobility, but there are exceptions. Please describe a specific twist boundary which has rather large twist angle and high grain boundary mobility. (10%)
9. Two screw dislocations are gliding on two perpendicular slip planes. Please describe the configuration and mobility of the two dislocations after their intersection. (10%)