國立臺灣科技大學 104 學年度碩士班招生試題

系所組別：機械工程系碩士班戊組

科　　目：材料原理

(總分為 100 分)

1. (10%) 你如何運用 snell's law 來設計一組光纖系統? (5%) 假設在光洩漏最小的條件下，若光纖的折射率為 1.5, 請問在空氣中光入射光纖的角度與光纖軸向成多少度? (5%)

2. (8%) (a)熱傳導是怎麼發生的? 請說明其機制。(4%) (b)何謂"Thermal shock"? 請說明為何康寧公司的透明玻璃陶瓷鍋具可直接置於瓦斯爐上，反復開火關火而不碎裂? (4%)

3. (8%) (a)鋼橋、鋼製大油槽，常用所謂的陰極保護法(Cathodic protection)來防止腐蝕，請說明。(4%) (b)有些易腐蝕的金屬工件，常用所謂的陽極保護法(Anodic protection)來抗蝕，請說明如何進行。(4%)

4. (14%) (a)你要設計一台電動車，電動車的起動馬達用到磁鐵，請問該磁鐵該擁有的特性為何?請以該磁鐵的遲滯曲線為例說明。(7%) (b) 鐵電材料(Ferroelectrics)也有遲滯曲線，請問鐵電材料有何特殊的性質? 其定義為何? 請說明其產生遲滯現象的原因。(7%)

5. (10%) (a)請於一個拉伸應力應變圖中，繪出金屬、橡膠、陶瓷三種材料之應力應變曲線，並說明其特徵。(5%) (b)請比較灰鑄鐵及低碳鋼的應力應變特徵。(5%)

6. (10%) (a) Would you expect steel or ceramic to have the higher binding energy? Explain (5%) (b)When a protective coating of ceramic is applied to a steel plate. What do you expect to happen to the coating when the temperature of the steel is increased significantly? Explain. (5%)

7. (10%) Indium has a tetragonal structure with a_0=0.32517 nm and c_0=0.49459 nm. The density is 7.286 g/cm^3, and the atomic weight is 114.82 g/mol. Does indium have the simple tetragonal or body-centered tetragonal structure?

8. (10%) The yield strength of titanium is found to be 448MPa when the grain size is 17μm and 565MPa when the grain size is 0.8μm. (a) Explain the phenomena, considering the defects in a material and dislocation motion (5%) (b) Determine the yield strength of the titanium when the grain size is reduced to 0.2 μm. (5%)

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9. (10%) The diffusion data for atoms (C and Fe) in iron (BCC and FCC structure) are summarized in the table below.

Diffusion Couple	Activation energy, Q (J/mol)
C in FCC Iron	1.38×10^5
C in BCC Iron	8.74×10^4
Fe in FCC Iron	2.79×10^5
Fe in BCC Iron	2.46×10^5

(a) Why is the activation energy for Fe diffusion higher than that for C diffusion in iron? (5%)

(b) Why is the activation energy for diffusion higher in FCC iron when compared to BCC iron? (5%)

10. (10%) A Pb-30%Sn alloy is melted at 300°C and then cooled very slowly to 25°C. Describe the development of phases during solidification. Please show your answer schematically by indicating the phases present and their microstructures at 300°C, 200°C, 183°C and 25°C.