

八十五學年度 材料科學工程研究所(系)(所) 甲 四 組碩士班研究生入學考試

機械材料 科號 2303 共 2 頁第 1 頁 *請在試卷【答案卷】內作答
2403

1. What is the crystal structure of aluminum metal? The lattice constant of aluminum is 0.4045 nm, calculate the atomic radius (R) and the mass density (ρ). The atomic mass of aluminum is 26.98. (10%)
2. Consider that two different cooling processes, **furnace cooling** and **quenching**, are performed after austenization treatment of a plain carbon steel. (a) What are the differences in the final products (phases)? (b) **Compare and explain** their differences in the mechanical strength and the toughness. (10%)
3. (a) What are the major processing steps in the **precipitation hardening** treatment of a metallic alloy? (b) Explain the **purpose** and the **physical principle** of each processing step in (a). (12%)
4. Name three methods to increase the mechanical strength of a **single phase** metal. Explain their strengthening mechanisms (principles). (12%)
5. Explain the purpose and the principle of the vulcanization of a rubber. (6%)

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6. (10%) 請繪出 (1) $\text{MgO}-\text{FeO}$ 及 (2) $\text{MgO}-\text{Al}_2\text{O}_3$ 之相圖 (熔點: $\text{MgO}(2800^\circ\text{C})$, $\text{FeO}(1380^\circ\text{C})$, $\text{Al}_2\text{O}_3(2100^\circ\text{C})$; $\text{MgAl}_2\text{O}_4(2200^\circ\text{C})$, 共晶溫度: $\text{MgO}-\text{MgAl}_2\text{O}_4(1985^\circ\text{C})$, $\text{MgAl}_2\text{O}_4-\text{Al}_2\text{O}_3(1855^\circ\text{C})$; $\text{MgO}-\text{FeO}$ 爲固溶體.)

7. (10%) 請利用能帶 (energy band) 的觀點解釋金屬, 半導體及絕緣體之導電率不同的原因, 並據以解釋它們導電率隨溫度的變化.

8. (10%) 請繪出 BaTiO_3 之晶體結構, 並據以說明其鐵電之電滯曲線, (ferroelectric hysteresis loop)

9. (10%) 利用鍍鋅 (Zn) 或鍍錫 (Sn) 均能防止鋼板 (Steel) 被腐蝕. 請問這兩種方法防蝕的機制 (mechanism) 有何不同?

10. (10%) 典型的硼玻璃含有 81% SiO_2 , 2% Al_2O_3 , 4% Na_2O 及 12% B_2O_3 . 請問上述四種氧化物的作用爲何?