

國立臺北科技大學 102 學年度碩士班招生考試

系所組別：3301 材料科學與工程研究所

第二節 材料科學與工程導論 試題 (選考)

第一頁 共一頁

注意事項：

1. 本試題共九題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. Sketch a base-centered orthorhombic unit cell and determine the number of lattice points per cell in the lattice. (8%)
2. Calculate the planar packing fraction of (110) in NaCl crystal. The radius of sodium and chloride ions is 0.097 nm and 0.181 nm. (10%)
3. (a) What is self-diffusion in metals? (4%)
(b) How is the rate of self-diffusion of atoms in metals measured experimentally? (4%)
(c) What is the mechanism for self-diffusion in metals? (4%)
4. If a stress of 50 MPa is applied in the [112] direction of an FCC single crystal. It will cause the dislocations to move on the (111) slip plane.
(a) Calculate the resolved shear stress acting on the possible slip systems. (9%)
(b) Which slip system(s) will become active first? (5%)
5. Describe the characteristic features of the fracture surface, including macroscopic and microscopic examinations, associated with a typical fatigue failure. (8%)

6. (a) Sketch a typical eutectic phase diagram with components A (melting point: 800°C) and B (melting point: 900°C). The maximum solubility of B in A (= 18 wt%) is larger than that of A in B (= 12 wt%), and both A and B are completely insoluble in each other at room temperature. The eutectic composition occurs at 46% B, and the eutectic temperature is 500°C. Label the axes of the diagram. Label all the phases. Use α and β to denote the solid phases, L to denote the liquid phase. (8%)
(b) Determine the amount of each phase in the eutectic microconstituent at 499°C. (4%)
(c) Sketch the equilibrium cooling curve from above the eutectic to room temperature for an alloy of eutectic composition. (4%)
7. A brass rod has an initial gage length of 50 mm and a diameter of 20 mm. When a tensile load of 55400 N is applied, the rod will be deformed homogeneously with an elongation of 12 mm. Calculate the true stress and true strain. (10%)
8. What is the driving force for (a) sintering, (b) grain growth, (c) diffusion, and (d) recrystallization? (8%)
9. (a) What is the donor level for a semiconductor? (4%)
(b) Sketch and explain the reverse bias on a $p-n$ junction diode. (5%)
(c) Describe how a light emitting diode operates. (5%)