107MM02

國立臺北科技大學 107 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

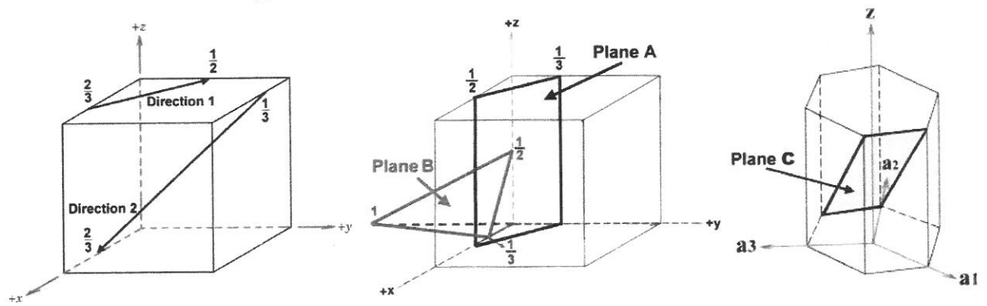
第二節　材料科學與工程導論　試題　（選考）

注意事項：

1. 本試題共**九題**，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. Please define and explain the following terms: **(20%)**
   (a) Whisker and Hybrid Composite
   (b) Slip system and Fracture Toughness K_c
   (c) Fatigue Strength and Creep
   (d) Polarization and Passivity
   (e) Normalizing and Full Annealing

2. (a) Determine the indices for the two directions (directions **1** and **2**) shown in the following cubic unit cell? **(6%)**
   (b) What are the Miller indices for the three planes (planes **A**, **B** and **C**) drawn in the following sketch? **(6%)**



3. Please completely explain the "Anelasticity"? **(2%)**
   Furthermore, please completely describe the properties and distinctive characteristics of carbon nanotubes and graphene. **(6%)**

4. The metal platinum has a FCC crystal structure, please compute:
   (a) The interplanar spacing? **(5%)**
   (b) The diffraction angle for the (113) set of planes. **(5%)**
   Assume that the monochromatic radiation having a wavelength of 0.154 nm is used, the atomic radius of R is 0.1387 nm, and the order of reflection is 1.

5. (a) A load of 140,000 N is applied to a cylindrical specimen of an alloy steel displaying the stress and strain behavior shown in **Fig. 1** that has a cross-sectional diameter of 10 mm. If the original specimen length is 600 mm, how much will it increase in length when this load is applied? **(5%)**
   (b) Consider a cylindrical specimen of some hypothetical metal alloy that has a diameter of 8.0 mm. A tensile force of 1000 N produces an elastic reduction in diameter of 2.8×10^{-4} mm. Compute the modulus of elasticity for this alloy, given that Poisson's ratio is 0.30. **(5%)**

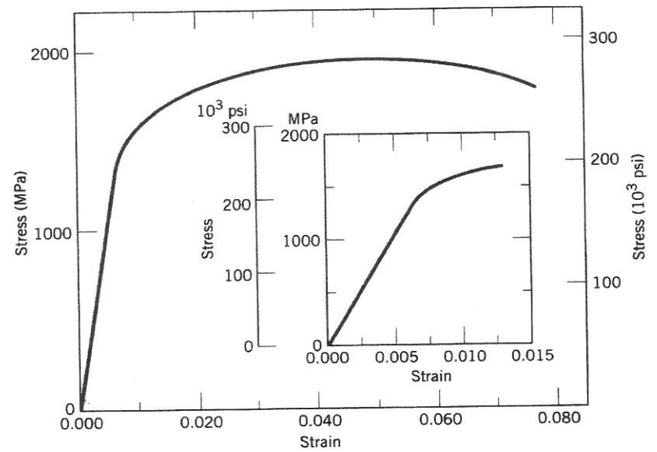


Fig. 1 Tensile stress-strain behavior for an alloy steel

6. At what temperature will the diffusion coefficient for the copper in aluminum have a value of 6.5×10^{-17} m^2/s. The value of D_0 and Q_d is 6.5×10^{-5} m^2/s and 136 kJ/mole, respectively. **(4%)**
   What's the solid-solution strengthening? Furthermore, please use the basis of dislocation to explain the strain-hardening phenomenon? **(6%)**

7. Please completely explain the continuous cooling transformation (CCT) and draw the CCT diagrams. **(4%)**
   On the other hand, please describe the properties and characteristics of martensite and tempered martensite, respectively. Meanwhile, please briefly explain the temper embrittlement, and how to improve it? **(6%)**

注意：背面尚有試題

8. Please completely describe the plastic deformation mechanism for crystalline and noncrystalline ceramics, respectively. **(4%)**
   In addition, please completely define the intergranular corrosion and galvanic corrosion. Meanwhile, please write the measures (at least two) to reduce the effects of intergranular corrosion and galvanic corrosion, respectively. **(6%)**

9. For a 76 wt% Pb-24 wt% Mg alloy (as shown in **Fig. 2**), make schematic sketches of the microstructure that would be observed for conditions of very slow cooling at the following temperatures: 575°C **(2%)**, 500°C **(2%)**, 450°C **(3%)**, and 300°C **(3%)**. Please must label all phases and indicate their approximate compositions.

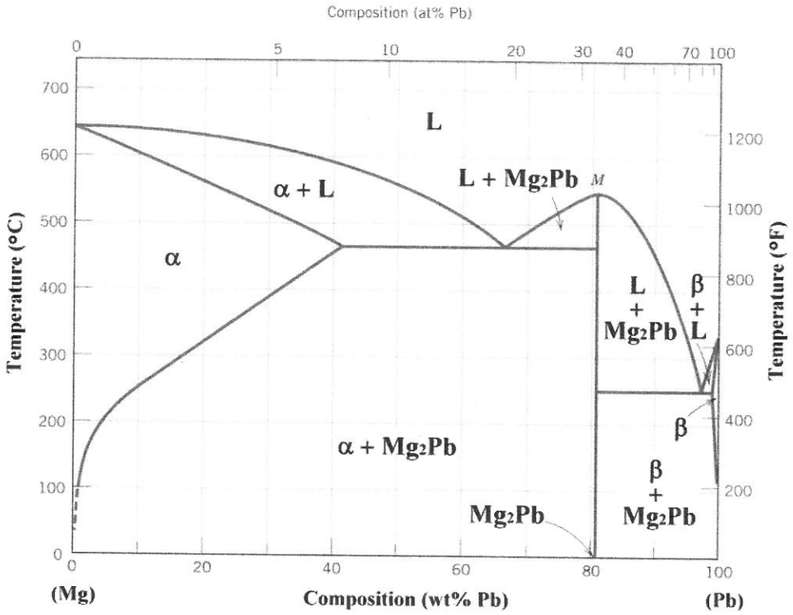


Fig. 2 Phase diagram of Mg-Pb alloy