

MM02

國立臺北科技大學 108 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 共二頁

注意事項：

1. 本試題共九題，共 100 分。
2. 不必抄題，作答時請將試題題號及答案依照順序寫在答案卷上。
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) Twin boundaries and Passivity
 - (b) Anelasticity and Spheroidizing
 - (c) Unit cell and Single crystal
 - (d) Intermetallic compound and Intergranular corrosion
 - (e) Shape memory alloy (SMA) and Supercooling

2. (a) Please completely explain the three processes and phenomenon of annealing treatment? (5%)
 (b) Furthermore, please completely define and explain the recrystallization temperature? And then to describe the effects of cold work and impurity of the alloy on recrystallization rate and recrystallization temperature, respectively? (5%)

3. (a) Please calculate the radius of an iridium atom, given that Ir (Iridium) has an FCC crystal structure, a density of 22.4 g/cm³, and an atomic weight of 192.2 g/mol. (5%)
 (b) The metal iron has a BCC crystal structure. If the angle of diffraction for the (310) set of plane occurs at 46.21° (first-order reflection) when monochromatic x-radiation having a wavelength of 0.071 nm was used, please compute the atomic radius for the iron atom. (5%)

4. Figure 1 is the tin-gold phase diagram, for which only single-phase regions are labeled. Please specify and write the composition-temperature points at which all eutectics (2), peritectics (3) and congruent (1) phase transformations occur. Also, for each, please write the reaction upon cooling. (10%)

For example, there are three peritectics. Among them, one exists at 30 wt% Au-70 wt% Sn, and 252°C. Its reaction upon cooling is as follows: $L + \gamma \rightarrow \beta$

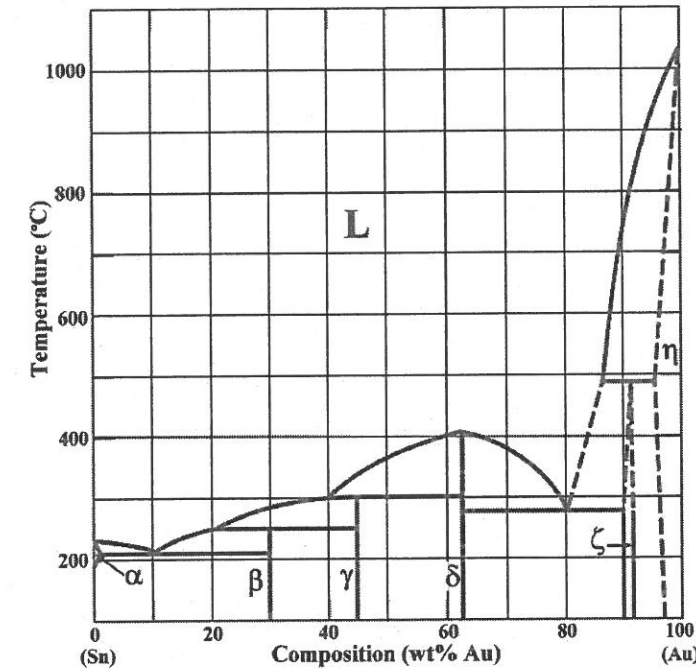


Figure 1 Phase diagram of Sn-Au alloy.

5. Please answer the following questions:
 - (a) The diffusion coefficients for iron in nickel are given at two temperatures:

T (°C)	D (m ² /s)
1000	9.4×10^{-16}
1200	9.4×10^{-14}

 What is the magnitude of D at 1100°C? (5%)
 - (b) Please draw a typical stress-strain picture of metal materials which has the yield phenomenon, and then to define and explain of the elastic limit, proportional limit and tensile strength, respectively. (5%)

6. (a) Please completely define and explain the Fullerenes (3%). Moreover, please briefly describe and explain the glass transition temperature (T_g) (2%).
 (b) On the other hand, please completely draw the morphology of HCP unit cell, and write the number of interior atoms and coordination number per HCP unit cell? Meanwhile, please calculate the APF (atomic packing factor) of HCP structure? (5%)

注意：背面尚有試題

7. (a) A sheet of steel 2.5 mm thick has nitrogen atmospheres on both sides at 900°C and is permitted to achieve a steady-state diffusion condition. The diffusion coefficient for nitrogen in steel at this temperature is $1.2 \times 10^{-10} \text{ m}^2/\text{s}$, and the diffusion flux is found to be $1.0 \times 10^{-7} \text{ kg/m}^2 \cdot \text{s}$. Also, it is known that the concentration of nitrogen in the steel at the high-pressure surface is 2 kg/m^3 . How far into the sheet from this high-pressure side will the concentration be 0.5 kg/m^3 ? Assume a linear concentration profile is acquired in this question. (5%)

(b) A cylindrical specimen of a nickel alloy having an elastic modulus of 207 GPa and an original diameter of 10.2 mm will experience only elastic deformation when a tensile load of 8900 N is applied. Compute the maximum length of the specimen before deformation if the maximum allowable elongation is 0.25 mm. (5%)

8. (a) Please briefly define the fatigue strength? (2%)

In addition, the fatigue data for a brass alloy are given as follows:

Stress Amplitude (MPa)	Cycles to Failure
248	1.0×10^5
236	3.0×10^5
224	1.0×10^6
213	3.0×10^6
201	1.0×10^7
193	3.0×10^7
193	1.0×10^8
193	3.0×10^8

(b) Make an S-N plot (stress amplitude versus logarithm cycles to failure) using these data. (2%)

(c) What is the fatigue limit for this alloy? (2%)

(d) Determine the fatigue lifetimes at stress amplitudes of 230 MPa. (2%)

(e) Determine the fatigue strength at 6×10^6 cycles. (2%)

9. (a) Please completely define the stainless steel. Moreover, according to the different microstructure, please describe the characteristics of three kind stainless steel, respectively. (4%)

(b) In addition, please draw a phase diagram to describe and completely explain the two different heat treatments that are used to precipitation harden a metal alloy. (6%)