國立高雄大學 104 學年度研究所碩士班招生考試試題

科目：材料科學導論
考試時間：100 分鐘

系所：化學工程及材料工程學系（乙組）
本科原始成績：100 分

是否使用計算機：是

1. Please describe and define the following terms (25%)
   (a) amorphous
   (b) anisotropic
   (c) Schottky defect
   (d) specific strength
   (e) biomaterials

2. Fig. 1 shows the first five peaks of the X-ray diffraction pattern for tungsten (W), which has a BCC crystal structure; monochromatic X-radiation having a wavelength of 0.1542 nm was used. (Hint: sin 20.1°=0.3436)
   (a) Index (i.e., give *h*, *k*, and *l* indices) for the first peak. (5%)
   (b) Determine the interplanar spacing for the first peak. (5%)
   (c) For the first peak, determine the atomic radius for W. (5%)

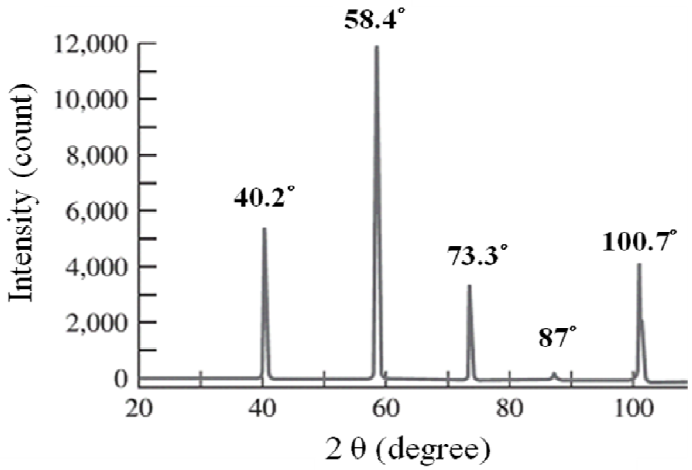

Fig. 1

3. Three identical fatigue specimens (denoted A, B, and C) are fabricated from a nonferrous alloy. Each is subjected to one of the maximum-minimum stress cycles listed below; the frequency is the same for all three tests.

Specimen	σ_{max} (MPa)	σ_{min} (MPa)
A	+450	−350
B	+400	−300
C	+340	−340

   (a) Rank the fatigue lifetimes of these three specimens from the longest to the shortest. (5%)
   (b) Now justify this ranking using a schematic S–N plot. (10%)

背面尚有試題

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4. In Fig. 2, for a 40 wt% Sn－60 wt% Pb alloy at 150°C,
   (a) What phase(s) is (are) present? (4%)
   (b) What is (are) the composition(s) of the phase(s)? (4%)
   (c) Calculate the relative amount of each phase present in terms of mass fraction. (6%)
   (d) Calculate the relative amount of each phase present in terms of volume fraction. At 150°C take the densities of Pb and Sn to be 11.23 and 7.24 g/cm^3, respectively. (6%)

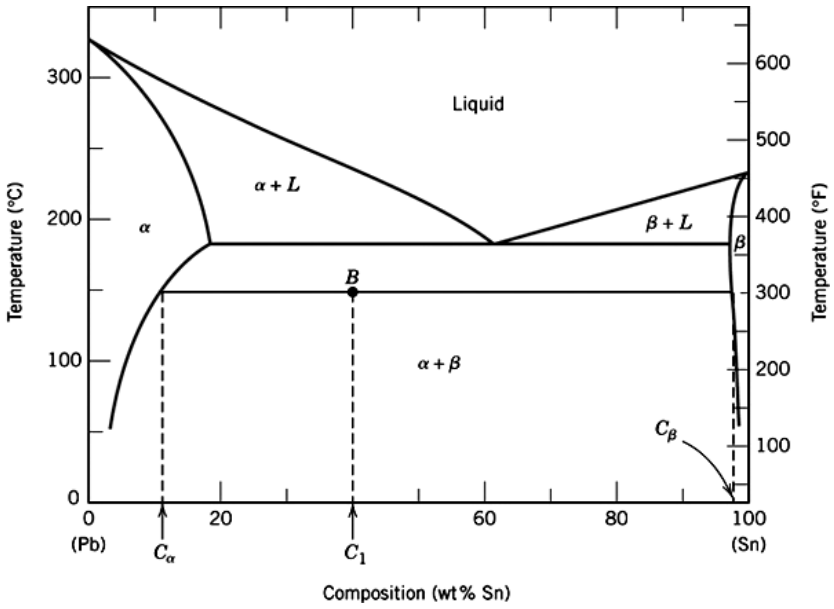

Fig. 2

5. Rank the following iron-carbon alloys and associated microstructures from the highest to the lowest tensile strength:
   0.25 wt% C with spheroidite
   0.25 wt% C with coarse pearlite
   0.6 wt% C with fine pearlite, and
   0.6 wt% C with coarse pearlite.
   Justify this ranking. And explain your answer. (10%)

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6. (a) According to the following Table, briefly explain why lead and tin do not strain harden when deformed at room temperature. (10%)

(b) Would you expect a crystalline ceramic material to strain harden at room temperature? Why or why not? (5%)

Table. Recrystallization and melting temperatures for lead and tin.

Metal	Recrystallization temperature (°C)	Melting temperature (°C)
Lead	−4	327
Tin	−4	232