

國立臺灣科技大學 112 學年度碩士班招生試題

系所組別：材料科學與工程系碩士班丙組

科目：材料導論

(總分為 100 分；所有試題務必於答案卷內頁依序作答，否則不予計分)

1. (10%) For a ferromagnetic material,
 - (1) (4%) Draw a saturation magnetization (M_s) vs. temperature (T) curve showing the behavior of the material.
 - (2) (6%) For the curve in (1), identify the regions for ferromagnetic behavior and paramagnetic behavior, and the point for Curie temperature in the above curve.
2. (10%) Calculate the mobility of the oxygen ions in UO_2 at 400 K. The diffusion coefficient of O^{2-} at this temperature is $10^{-10} \text{ cm}^2/\text{s}$.
3. (10%) For an n-type semiconductor doped with 10^{22} m^{-3} of donor impurity,
 - (1) (4%) Draw an electron concentration (n_e) vs. temperature (T) curve.
 - (2) (6%) Indicate the freeze-out region, extrinsic region, and intrinsic region in the curve in (1).
4. (10%) For an iron-carbon alloy of eutectoid composition,
 - (1) (2%) Draw an isothermal transformation diagram (temperature vs. time diagram).
 - (2) (8%) Indicate the paths for forming coarse pearlite, fine pearlite, mixed martensite and pearlite, and martensite in the diagram in (1).
5. (10%) Draw an approximate hypothetical phase diagram for two metals that have unlimited solubility in each other with the following information:
 - Melt temperature of metal A is 1084°C .
 - Melt temperature of metal B is 1455°C .
 - At 1300°C , the wt% of metal B in the liquidus alloy is 45%.
 - At 1300°C , the wt% of metal B in the solidus alloy is 57%.
 - At 1300°C , the wt% of metal B in the overall alloy is 53%.



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6. (13%) A cylindrical hypothetical alloy X was subjected to a tensile test. The original diameter and length of the cylindrical alloy rod were 20 mm and 50 mm, respectively. It is known that there is a 2×10^{-3} mm change in diameter and the deformation is entirely elastic. The elastic modulus and Poisson's ratio for alloy X are 100 GPa, and 0.25, respectively. Please answer the following questions.
- (1) (3%) Determine the lateral strain.
 - (2) (5%) Determine the elongation (change in length) along the tensile force direction.
 - (3) (5%) Determine the external force for the tensile test.
7. (9%) Recovery, recrystallization, and grain growth are three major annealing phenomena. Please describe the driving forces for these three annealing phenomena.
8. (8%) Below are the photos of brass under several stages including:
- (a) 33% cold-worked grain structure, (b) Partial recrystallization at 580°C for 4s, (c) Complete recrystallization at 580°C for 8s, and (d) Grain growth at 580°C for 15min. Please match (a), (b), (c), and (d) with (i), (ii), (iii), and (iv) below.

(i) (2%)

(ii) (2%)

(iii) (2%)

(iv) (2%)



9. (14%) Stress concentration is an important phenomenon that will affect the mechanical properties of materials.
- (1) (10%) Please give the stress concentration equation assuming the presence of an elliptical hole. (The meanings of the symbols must be given for complete scores.)
 - (2) (4%) Please further use the equation in (1) to explain why stress will more easily concentrate at a sharp tip than at a round tip.
10. (6%) Cation interstitial, cation vacancy, and anion vacancy are three basic point defects in ceramic compounds. Please explain why there is no anion interstitial point defect in ceramic compounds.

