國立交通大學 103 學年度碩士班考試入學試題

科目：材料科學與工程導論(3152)　　　　　考試日期:103年2月15日 第4節
系所班別：材料科學與工程學系　　　組別：材料系甲組　　第 / 頁, 共 2 頁
【可使用計算機】＊作答前請先核對試題、答案卷(試卷)與准考證之所組別與考科是否相符！！

1. (8 points)
Calculate the planar density for the following planes:
(a) BCC (110) and (b) FCC (110).　(4 + 4 points)

2. (10 points)
The figure below shows the concentration profiles for a diffusion couple of Cu/Ni at time t_1.
(a) Draw the concentration profiles at a longer time t_2.　(6 points)
(b) Use Fick's 2nd Law for diffusion to explain the evolution of the concentration profiles at different times. (4 points)
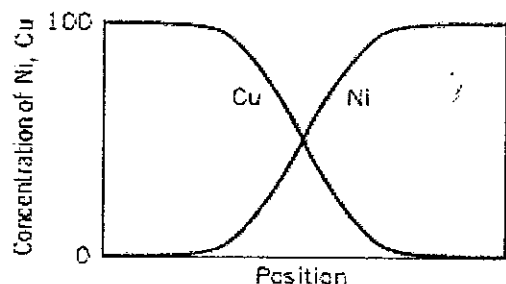
3. (7 points)
(a) Draw a typical tensile stress-strain curve for crystalline metals. (3 points)
(b) Explain what the toughness is.　(4 points)

4. (8 points)
The average grain diameter of an aluminum alloy is 14 μm with a strength of 185 MPa. The same alloy with an average grain diameter of 50 μm has a strength of 140 MPa.
(a) Determine the constants for the Hall-Petch equation for this alloy. (4 points)
(b) How much more should you reduce the grain size if you desire a strength of 220 MPa? (4 points)

5. (7 points)
Please explain isothermal transformation and continuous cooling transformation and give an example to illustrate these transformations based on Iron-Carbon alloy.

6. (10 points)
Please describe the sources of magnetic anisotropy.

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7. (15 points)

$BaCO_3$ + TiO_2 powders were used to prepare $BaTiO_3$ using mixed oxide techniques through Ball Mixing, Calcination, Ball Milling, Forming and Sintering.

Please explain the meaning and purpose of Calcination, Ball Milling, and Sintering. (5 points each)

8. (10 points)

ZnO is a Zinc blende structure and its sintering is dominated by diffusion of oxygen ions.

(a) Please draw the crystal structure. (4 points)

(b) If the compound is cation-deficient, propose a method to increase the sintering rate. (6 points)

9. (7 points)

Which of the following polymers is least likely to be optically transparent, (name the polymer, 3 points) and why (4 points)?

(a) Atactic polystyrene, (b) Isotactic polystyrene, (c) An ethylene/propylene random copolymer (50/50 composition), or (d) A styrene/butadiene random copolymer

10. (8 points)

For each of the following two polymers, plot and label a schematic specific volume-versus-temperature curve (include both curves on the same graph): (4 points each)

(a) Spherulitic polypropylene, of 25% crystallinity, and having a weight-average molecular weight of 75,000 g/mol

(b) Spherulitic polystyrene, of 25% crystallinity, and having a weight-average molecular weight of 100,000 g/mol.
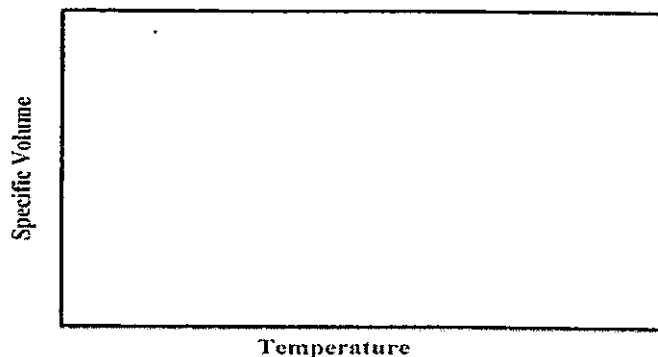
11. (10 points)

For each of the following pairs of materials, decide which has the larger band-gap energy, Eg. Explain your choices (5 points each)

(a) GaAs *vs.* InSb

(b) Si *vs.* Ge