國立臺灣大學98學年度碩士班招生考試試題

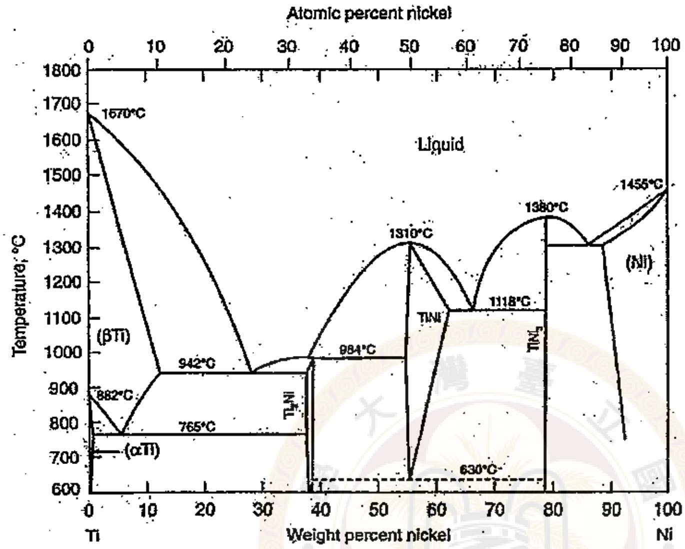
※ 注意：全部題目均請作答於試卷內之「非選擇題作答區」，請標明題號依序作答。

1. The titanium-nickel (Ti-Ni) phase diagram is shown below.

(1) Write down all the invariant reactions show on this figure and specify temperature-composition points for each reaction. (4%)

(2) Draw the corresponding cooling curve (temperature vs. time plot) when a molten Ni-Ti alloy containing 50 atomic % Ni is slowly cooled down to 800℃. (4%)

(3) Calculate the degree of freedom of the Ni-Ti alloy containing 30 weight % Ti at 1200℃. Explain the significance of this number of degree of freedom. (4%)



2. Compare the precipitation hardening of aluminum alloy and the hardening of steel by quenching and tempering with regard to

(1) The total heat treatment procedure. (4%)

(2) The microstructures that develop. (4%)

3. Please choose the correct statement(s): (10%，複選題，答案全對才給分)

(A) Copper and Silver have face-centered cubic structure, but Magnesium and Zinc exhibit closed-packed hexagonal structure.

(B) Like α-Ferrite, the body-centered cubic lattice has both the closed-packed planes and closed-packed directions.

(C) The Miller indices of crystallographic planes can be identified by sets of integers. If the indicated plane of a cubic crystal intercepts the x, y, and z axes at 1, 3 and 2 unit-cell distances respectively, the Miller indices of this plane are (623).

(D) The coordination number of the body-centered cubic lattice is 8. However, the coordination number is 12 for both face-centered cubic and closed-packed hexagonal crystals.

4. (a) Please draw a continuous-cooling-transformation diagram and show the variation of microstructure as a function of cooling rate for an eutectoid steel. (5%)

(b) Please discuss briefly the influence of alloying elements on hardenability of a steel. (5%)

5. Draw the skeletal structure of cis-polyisoprene. (3%)

What is the vulcanization? (4%) What is the purpose of vulcanization? (3%)

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6. What are the differences between atatic polystyrene and syndiotatic polystyrene in terms of skeletal structure and morphology? (5%) What are the differences in terms of mechanical properties when the temperature reaches 120°C? Why? (5%)

7. If cupric oxide (CuO) is exposed to reducing atmospheres at elevated temperatures, some of the Cu^{2+} ions will become Cu^{+}.
   (a) Under such condition, name one crystalline defect that you would expect to form in order to maintain charge neutrality. (5%)
   (b) How would you express the chemical formula for this non-stoichiometric material? (5%)

8. In coffee shop such as Starbucks, hot coffee is usually served with ceramic cup. Please give two basic physical characteristics of ceramics for such applications. Please explain briefly. (10%)

9.
   (I) By extensive plastic deformation, you decrease the electron mean-free path in high purity copper by 10%. What will be the resulting changes in (i) the mobility (ii) conductivity (iii) Hall coefficient ? (please specify in terms of *increase, decrease, or unchanged*) (6%)
   (II) Diamond has a dielectric constant of 5.68. Calculate the (a) magnitude of polarization **P** , (b) electric displacement **D**, when diamond is exposed to an electric field of 1000 V/m? ($\varepsilon_0 = 8.85 \times 10^{-12}$ F/m) (4%)

10. For an intrinsic semiconductor, you can dope impurity atoms to make the semiconductor with different types of carrier transport. Fig.1 (a) shows the band diagram of an intrinsic semiconductor Si. E_C is the conduction band , E_V is the valence band and E_{Fi} is the Fermi level of an intrinsic semiconductor Si. The dash lines in (b) and (c) represent the Fermi levels after doping.

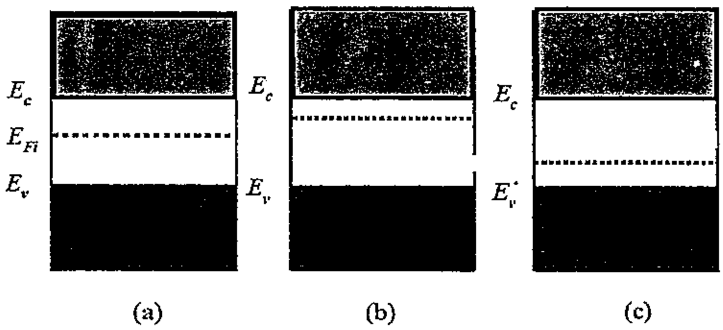

Fig.1

(I) In Fig.1(b), which element (or elements) you have chosen as a dopant ? (a) N (b) C (c) Al (d) P (e) B (f) As (g)S. (4%)

(II) In Fig.1(c), which element (or elements) you have chosen as a dopant ? (a) N (b) C (c) Al (d) P (e) B (f) As (g)S. (4%)

(III) In Fig.1 (a), (b) and (c), which one represents the semiconductor consisting of majority carriers of positive charges ? (2%)

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