

※ 考生請注意：本試題不可使用計算機。 請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. Write proper defect equations for the following processes:
 - (a) FeO is oxidized to Fe₂O₃ under oxidizing atmosphere considering iron vacancy as the principal charge compensating defect (5%)
 - (b) The solid solution or incorporation of Mg in Al₂O₃ assuming that Mg ions are incorporated interstitially into the Al₂O₃ structure with the formation of Al ion vacancies. (5%)
2. Explain under what conditions a precipitate particle will take the form of (a) a platelet and (b) a spheroid based on the Gibbs free energy. (10%)
3. For the reaction, CaCO_{3(s)}→CaO (s)+CO_{2(g)}, the dissociation pressure of CaCO_{3(s)} versus temperature are shown as Fig. 1.
 - (a) How many degrees of freedom are there in the regions I, II, and III? State the phases in each region. (5%)
 - (b) Estimate the value of ΔG° at 1000K. (5%)

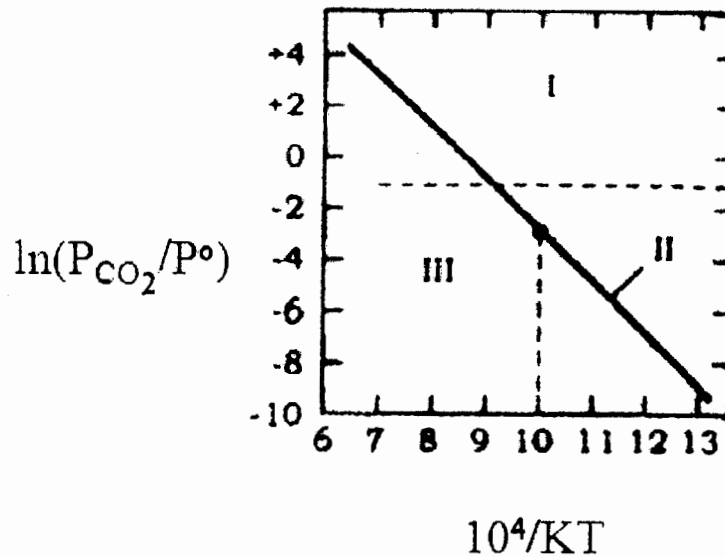


Fig.1

4. Consider the important ferroelectric ceramic compound BaTiO₃, which has the perovskite structure (Fig.2):
Please answer the following questions about barium titanate:
 - (a) Describe the crystal structure of BaTiO₃, citing specially (1) its overall Bravais lattice (2%) and (2) the coordination environment of Ba²⁺, Ti⁴⁺ and O²⁻ species. (3%)
 - (b) Calculate the lattice parameter (a₀) of BaTiO₃. (ionic radii data: Ti⁴⁺: 0.69Å, O²⁻: 1.32 Å, and Ba²⁺:1.68 Å) (5%)

(背面仍有題目,請繼續作答)

系所組別： 資源工程學系乙組

考試科目： 材料科學導論

考試日期：0222，節次：3

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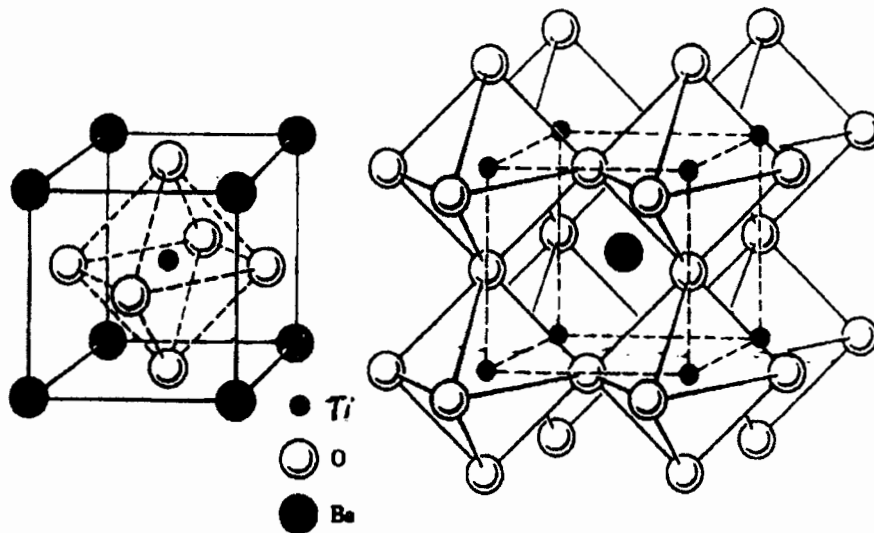


Fig.2

5. The Gibbs free energy change resulting from the formation of embryo consisting of n atoms can be described as:

$$\Delta G = -b n (\Delta G_v - E_s) + a n^{2/3} \gamma$$

Where ΔG_v : bulk free energy change; E_s : strain energy; γ :

interface energy; a , b : shape factors depend on the embryo shape

- (a) Calculate the values of a and b , if the embryo is spheroid. (5%)
 (b) Derive the activation energy to form the critical nuclei. (5%)
6. Please use the free energy versus composition curve to explain the main difference between spinodal decomposition and nucleation-growth phase transformation. (10%)
7. Explain why ordered crystals become disordered at a sufficiently high temperature in terms of Gibbs free energy. (8%)
8. Explain the difference among the insulators, n-type semiconductors, p-type semiconductors and metals in terms of band structures. (12%)
9. What are the six crystal systems? Define the crystal systems using crystallographic axes and their characteristic symmetry. (10%)
10. Figure 3 is the phase diagram of Na and K.
- (a) What kind of reaction at point p and c ? And state the reaction equation. (5%)
 (b) Consider a specimen at point g with a composition of Na_2K , state the reaction sequence (at points of f , e , b , n , and a) as the specimen is cooled from g to a . (5%)

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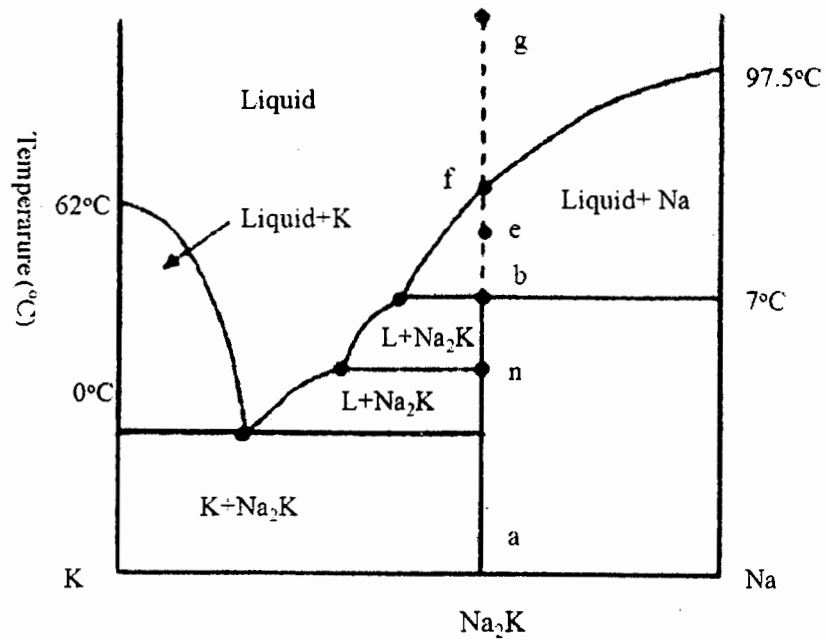


Fig.3