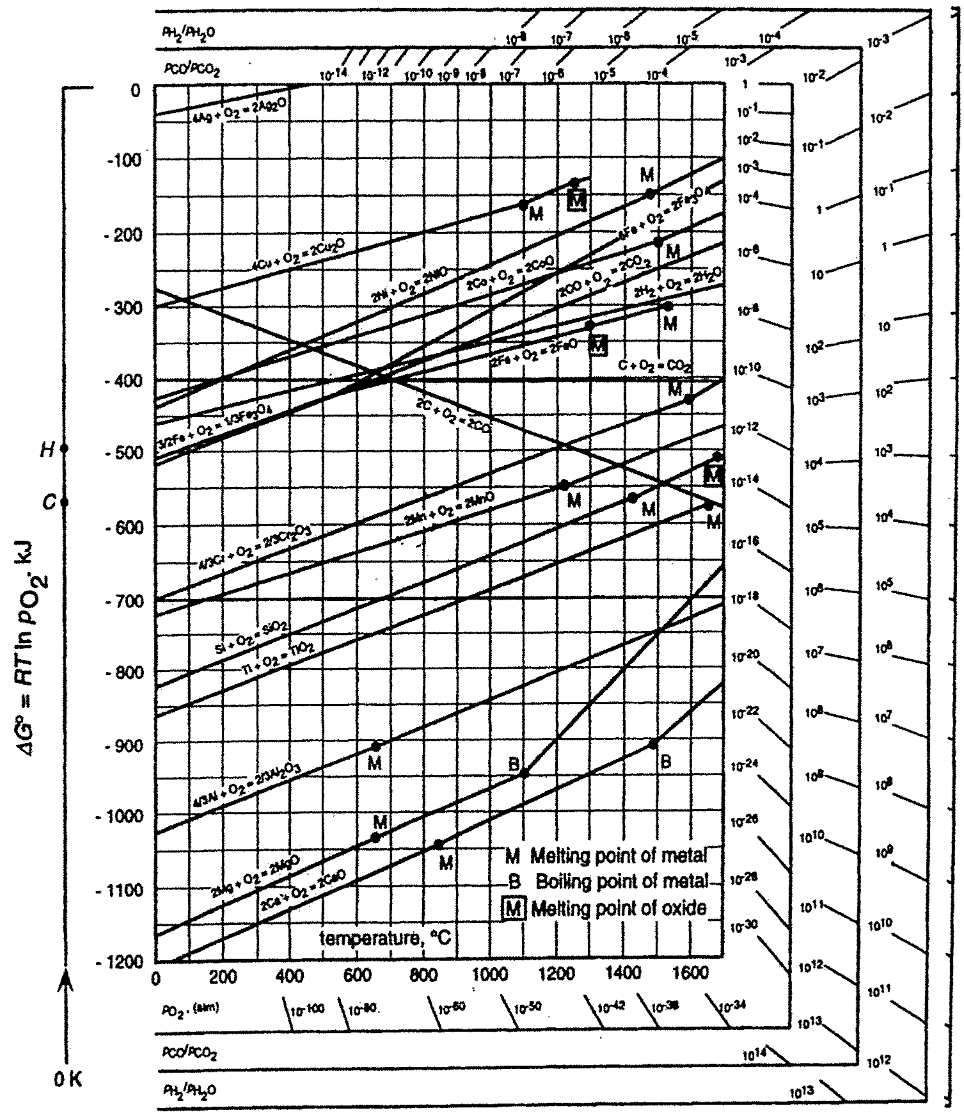
4. Use the Ellingham diagram to answer the following question.
   (a) (10%) If we want to grow a layer of SiO_2 over a clean Si wafer at 1000 °C in a vacuum chamber, what is the minimum O_2 pressure we must have in the chamber?
   (b) (5%) Continue the question in (a). If this O_2 pressure is maintained through the equilibrium between H_2 and H_2O, what ratio of H_2 over H_2O we must use?
   (c) (5%) Continue the question in (a). If this O_2 pressure is maintained through the equilibrium between CO and CO_2, what ratio of CO over CO_2 we must use?



The Ellingham diagram for selected oxides.

國立臺灣大學 105 學年度碩士班招生考試試題

5. A and B form a regular solution with the regular solution parameter Ω.
   (a) (5%) Write down the expression for the molar Gibbs free energy of mixing for this solution.
   (b) (5%) From your answer in (a), derive the expression for μ_A-μ_A^o.
   (c) (5%) If the bond energies for this system are ϵ_{AA}= -6.5x10^{-20}, ϵ_{BB}= -5.3x10^{-20}, and ϵ_{AB}= -5.4x10^{-20} (J/bond), calculate the value of Ω by assuming the coordination number equals 12.
   (d) (3%) Does atoms in the solution tends to clustering or tends to ordering? Explain why?
   (e) (5%) If we plot the molar Gibbs free energy of mixing as a function of the mole fraction of B (x_B), what are the physical meanings of the intercepts of a tangent line at x_B=0 and x_B=1 in the familiar "common tangent construction"? No derivation is required to receive this 5 points. Draw a schematic diagram to illustrate your answer.
   (f) (7%) Derive your answer for (e) and draw a schematic diagram to receive the 7 points.

試題隨卷繳回

1. (18%) Calculate the work done by the system of 1 mole mercury when the external pressure is changed from 0 to 10^7 kg/m^2 while the temperature is held isothermally at 25°C. Calculate also the heat flow out of the system as well as the change in internal energy. Write down all the necessary assumptions and also note for mercury
   the molar volume = 1.47×10^{-5} m^3/mol
   the isobaric thermal expansivity = 181×10^{-6} /K
   the isothermal compressibility = 3.7×10^{-11} m^2/N

2. (18%) 4.92 liter of a monoatomic ideal gas is at 327°C and 2 atm pressure. The pressure is suddenly released adiabatically to half its original pressure during which 249.42 J of work is performed. Calculate the change in entropy during this process. Note the gas constant R = 8.314 J/(mole K) = 1.987 cal/(mole K) = 0.082 (liter-atm)/(mole K) and the specific heat capacity at constant volume for a monoatomic ideal gas is equal to 1.5R.

3. Figure 1 is a schematic pressure-temperature phase diagram of iron.
   (a) (7%) Among the BCC, FCC, and liquid phases, an increase in pressure will favor the stability of which phase? Why?
   (b) (7%) Draw a schematic representation of the variation, with temperature at pressure P_1, of the molar Gibbs free energies of the BCC, FCC, and liquid phases.

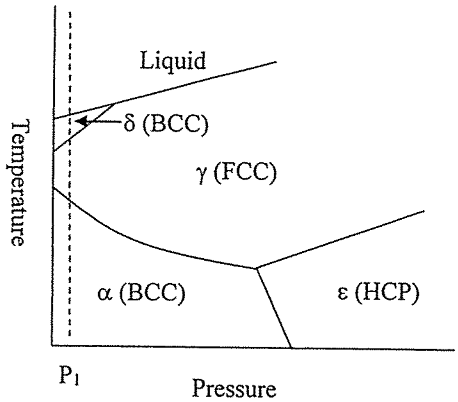


Figure 1

見背面