明志科技大學 101 學年度研究所碩士班一般考試暨在職專班招生命題用紙

所別：　材料工程研究所　　組別：＿＿＿＿＿＿＿＿＿＿　科目：　材料熱力學

注意：□不准□一般計算器☑工程用計算器，考試時間總計：100 分鐘。試題共 1 頁，第 1 頁

1. Gold and silicon are mutually insoluble in the solid state and form a eutectic system with an eutectic temperature of 636 K and a eutectic composition of $X_{Si}$ = 0.186. Calculate the Gibbs free energy of the eutectic melt relative to (a) unmixed liquid Au and liquid Si, and (b) unmixed solid Au and solid Si, with corresponding illustration. Knowing that,

   $\Delta H_{m,Au}^{\cdot}$ = 12600　J/mol　at $T_{m,Au}$ = 1338 K

   $\Delta H_{m,Si}^{\cdot}$ = 50200　J/mol　at $T_{m,Si}$ = 1658 K.

2. At a pressure of 1 atm the equilibrium melting temperature of silver is 961℃, and, at this temperature, the latent heat of melting of silver is 11200 J/mol. Calculate the enthalpy, entropy and Gibbs free energy of freezing 1 mole of supercooled liquid silver at 800℃, and explain if this occurs spontaneously. Knowing that for silver,

   $C_{p,s}$ = 21.2 + 8.55×10$^{-3}$T + 1.5×10$^5$T$^{-2}$　J/mol K

   $C_{p,l}$ = 30.5　J/mol K.

3. A rigid container is partitioned into n compartments with individual volume fraction of $V_A$, $V_B$, $V_C$, ..., while each compartment contains $n_A$, $n_B$, $n_C$, ... moles of ideal gas A, B, C, ..., respectively. Calculate the entropy change when the partitions are removed.

4. Tin obeys Henry's law in dilute liquid solutions of Sn and Cd and the Henrian activity coefficient of Sn, $\gamma_{Sn}^{\circ}$, varies with temperature as

   $$\ln \gamma_{Sn}^{\circ} = -840/T + 1.58$$

   Calculate the change in temperature when 1 mole of liquid Sn and 99 moles of liquid Cd are mixed in an adiabatic enclosure. The molar constant pressure heat capacity of the alloy formed is 29.5 J/K.

5. When 1 mole of argon gas is bubbled through a large volume of an Fe-Mn melt of $X_{Mn}$ = 0.5 at 1863 K evaporation of Mn into the Ar causes the mass of the melt to decrease by 1.50 g. The gas leaves the melt at a pressure of 1 atm. Calculate the activity coefficient of Mn in the liquid alloy. Knowing that the atomic mass of Mn is 54.94 g/mol, and the saturated vapor pressure of liquid Mn can be calculated as

   ln P (atm) = − 33440/T − 3.02 ln T + 37.68.

(每題 20 分)