國立台灣科技大學九十六學年度碩士班招生試題

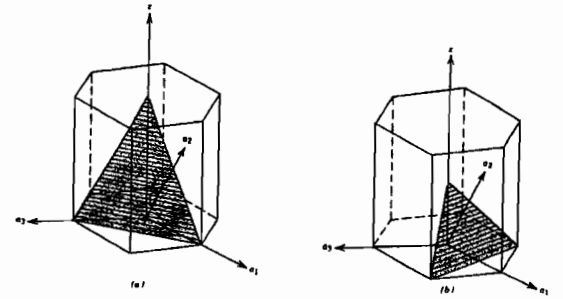
系所組別： 材料科技研究所碩士班

科　　目： 材料導論

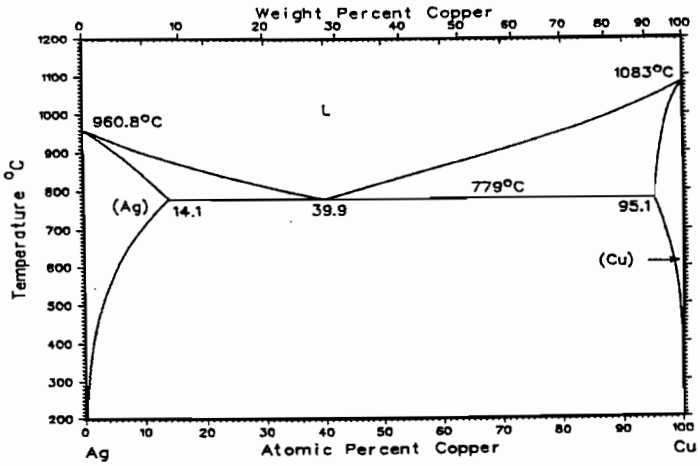
共 8 大題，總分 100 分；請於答案卷內依序作答。

1. Explain the following terms: (9%)
   (a) SEM, (b) First Law of Thermodynamics, (c) Excess property.

2. Determine the Miller indices for the planes (a) & (b) shown in hexagonal unit cell: (8%)



3. This binary phase diagram is the Ag-Cu binary phase diagram, as shown in below.
   (a) What is meaning of the composition at Ag-39.9 at.% Cu at 779℃ (3 %).
   (b) Is the Ag-60 at.% Cu alloy is a hypoeutectic alloy or a hypereutectic alloy? (2%)
   (c) What is the primary solidification phase in it? (2%)
   (d) Please draw the schematic microstructure showing the alloy's solidification microstructure at 800℃ and 500℃, where the alloy's composition is Ag-20 at.% Cu. Make sure the microstructure should follow the lever rule. (6%)



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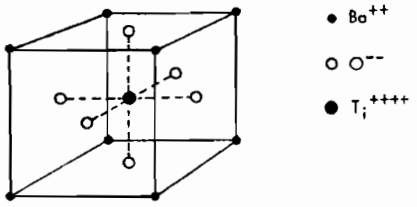
4 Calculate the ratio of the surface energies $\gamma_{(100)}$ to $\gamma_{(111)}$ for a face-centered cubic crystal. The magnitude of solid surface energy can be approximated by a simple calculation assuming that the binding energy of an atom to a solid is the result of breaking bonds to its nearest neighbors. (10%)

5. If zinc oxide is heated a low oxygen pressure, it will become conductive. Assume the defect structure is of the Frenkel type, with zinc ions occupying the interstitial position. How do the concentrations of electrons change with the oxygen pressure if the interstitial zinc ions are (a) doubly charged and (b) singly charged? (10%)

6. Draw band diagrams of (a) a metal and (b) an intrinsic semiconductor. Show relation between the Fermi energy and the work function in above drawings. (10%)

7. The unit cell of $BaTiO_3$ is shown in the accompanying diagram. The crystal system is cubic.
   a) What is the Bravais lattice?
   b) How many atoms are there per unit cell?
   c) Give the type and number of nearest neighbors for each atom.



(10%)

8. For aluminum, the heat capacity at constant volume C_v at 30 K is 0.81 J/mol-K, and the Debye temperature is 375 K. Estimate the specific heat at 55 K and 430 K. (30%)