國立臺南大學 104 學年度 **材料科學系碩士班** 招生考試 材料科學導論 試題卷

1. (a) What are the four important mechanisms by which atoms are bonded in engineered materials? (5%)
   (b) How do these mechanisms affect the physical properties of engineered materials, e. g. the melting temperature, the elasticity and the conductivity? (5%)

2. Determine the Miller indices for (a) the planes *A*, *B*, and *C*, (6%) and
   (b) the directions *D*, and *E* in Figure 1. (4%)

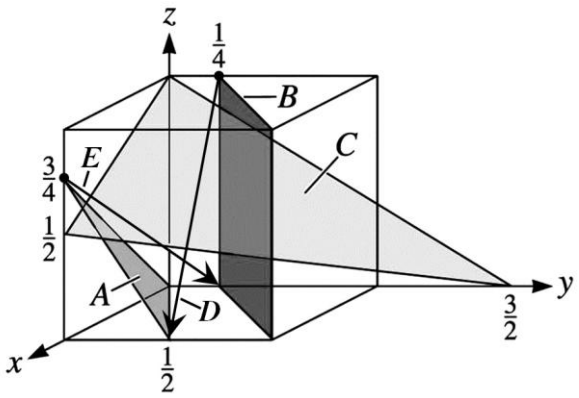

Figure 1 Planes and directions in a cubic unit cell

3. For each given temperature (T_1, T_2, T_3, T_4), draw a possible Gibbs free energy-composition diagram for each phase. (10%)

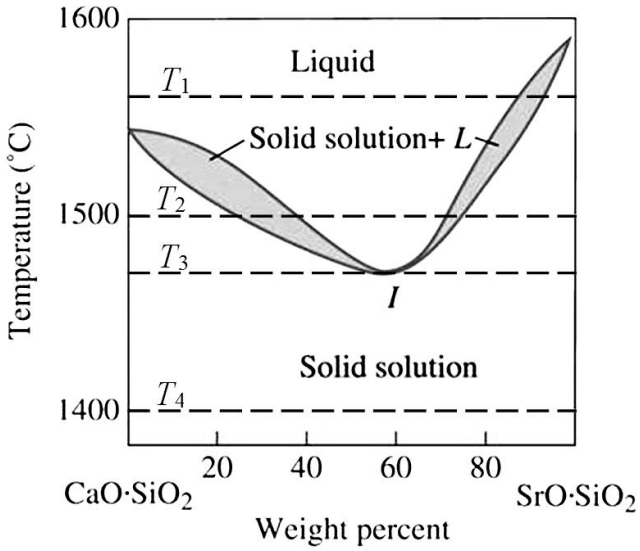

Figure 2 The equilibrium phase diagram for the $CaO{\cdot}SiO_2$-$SrO{\cdot}SiO_2$ system

4. A metal having a cubic structure has a density of 2.6 g/cm^3, an atomic weight of 87.62 g/mol, and a lattice parameter of 6.0849 Å. One atom is associated with each lattice point. Determine
   (a) the crystal structure, (5%) and
   (b) the atomic radius of the metal. (5%) (1 mol = 6.02×10^{23} atoms)

5. What are the requirements of a matrix and precipitate for dispersion strengthening to be effective? (10%)

6. Describe 3 types of crystalline defects and their respective roles in strengthening metals. (the names of strengthening mechanisms should be included in your answer) (10%)

7. Describe (with schematic diagrams) the band structures for metals, semiconductors, and insulators. (10%)

8. Describe (with schematic diagrams) the development of ingot structure (sometimes called macrostructure) of a casting during solidification. (10%)

9. Describe 3 three-phase reactions in binary phase diagrams. (10%)

10. Briefly explain the following terms. (a) true stress, (b) tensile strength, (c) direct bandgap in semiconductor, (d) critical resolved shear stress, and (e) strain hardening. (10%)