編號： 94

國立成功大學 107 學年度碩士班招生考試試題

系　　所：資源工程學系

考試科目：材料科學導論

考試日期：0205，節次：3

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

1. The crystal structure of Fe_3O_4 is spinel.

(1-1) Using Pauling's rules #1 and #2, determine the coordination numbers of Fe^{2+} and Fe^{3+}, and the numbers of Fe^{2+} and Fe^{3+} around each O atom. (10%)

where ionic radius of Fe^{2+} and Fe^{3+} are as below:

Fe^{2+}: 0.63 Å [IV], 0.78 Å [VI], 0.92 Å [VIII]

Fe^{3+}: 0.65 Å [VI], 0.78 Å [VIII]

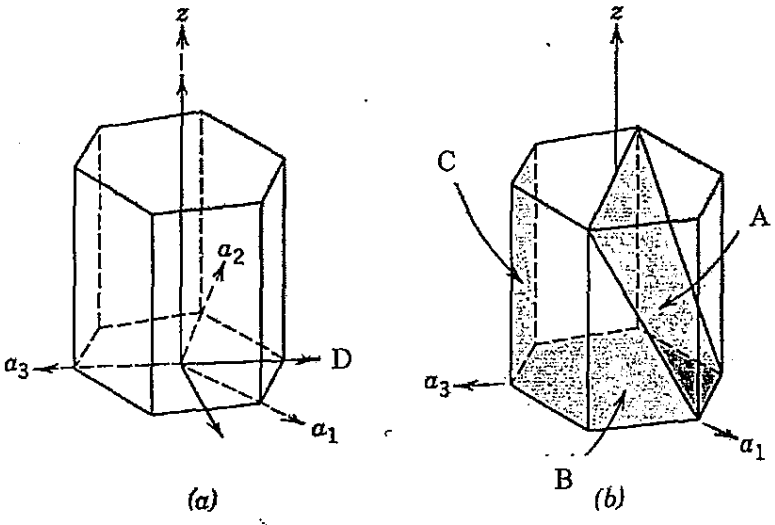
O^{2-}: r(O) = 1.35 Å

(1-2) The oxygen ions of Fe_3O_4 will arrange in FCC structure. Identify and draw the positions of the FCC octahedral and tetrahedral interstices and calculate the total and occupied numbers of constitutional atoms, tetrahedral and octahedral sites. (10%)

(1-3) Please explain why Fe_3O_4 exhibits magnetic property. (5%)

(1-4) What is the Pauling's 3rd rule? (5%)

2. Determine the Miller indices for the planes shown in the following unit cell (b) A、B、C and indices for the directions shown in the following unit cell (a) D. (10%)



3. Please explain the effects of undercooling on the nucleation rate for homogeneous nucleation. (10%)
4. Please explain why almost the grain growth does not occur until final sintering stage and how to inhibit the grain growth in the final sintering stage. (10%)
5. Please use the relationship between Free energy and composition curve to explain the difference between the spinodal decomposition and nucleation and growth. (10%)
6. Please explain the difference among unstable, metastable, and stable state using the schematic diagram of the variation of Gibbs free energy with position. (10 %)
7. Please explain the meaning of the space group, C mm2, including the crystal system, Bravais lattice, symmetry element. (10%).

8. The phase diagram of SiO_2 is as below. Note that β-quartz, cristobalite and tridymite all are high temperature phases. However, cristobalite and tridymite are often observed and β-quartz is not found at room temperature. Please explain why? (10%)