

國立台灣科技大學九十五學年度碩士班招生試題

系所組別： 高分子工程系碩士班丁組

科 目： 材料科學

1. 共 6 大題，總分 100 分。 2. 請於答案卷內依序作答。

1. Metals or other materials may have several different crystal structures. Please answer following questions:

- (a) Explain the items (i) unit cell (UC), (ii) BCC, (iii) HCP. (each 3%)
- (b) What is the definition of APF (atomic packing factor) (3%)
- (c) Calculate the volume of an FCC unit cell in terms of the atomic radius R , where the length of unit cell is a ; and calculate the APF for FCC unit cell, as well. (each 9%)

2. The radii of Cs and Cl are 0.167 and 0.181 nm, respectively. The x-ray diffraction data of CsCl powder are measured with a radiation wavelength= 0.1542 nm. The atomic weight of Cs= 132.9 g/mol and Cl= 35.45 g/mol. The structure is simple cubic.

- (a) Find the length of unit cell. (3%)
- (b) Determine the diffraction angle for the (110) crystal plane. (4%)
- (c) Calculate the atomic packing factor of CsCl crystal. (3%)

3. The diffusion coefficients for copper in aluminum at 500 and 600 degrees centigrade are A and B meters squared per second, respectively.

- (a) Determine the approximate time at 500 degrees centigrade that will produce the same copper concentration in Al as a 10-hour heat treatment at 600 degrees centigrade at some specific position. Suppose the Cu concentration at one side of material is kept constant. (3%)
- (b) Find the activation energy for diffusion. (Gas constant $R= 8.314 \text{ J/mol-K}$) (4%)
- (c) Cu is allowed to diffuse through a plate 10 mm thick at 500 degrees centigrade. The Cu concentrations at the two faces are 0.0085 and 0.0040 kg Cu/cubic meter Al, respectively, which are maintained constant. Compute the diffusion flux in terms of kg per meter squared per second. (3%)

4. Nylon 6,6 is a sort of dielectric materials.

- (a) List two types of polarization occurring while this polymer is applied with an externally applied electric field. Explain each mechanism briefly. (4%)
- (b) Plot the variation of dielectric constant of material with frequency of an alternating electric field. (3%)
- (c) Compare the dielectric constant of moisture-free Nylon 6,6 with that of polytetrafluoroethylene (PTFE). Which one is bigger? Why? (3%)

45



國立台灣科技大學九十五學年度碩士班招生試題

系所組別： 高分子工程系碩士班丁組

科 目： 材料科學

5. Ordinary incident light strikes a polished glass plate 0.50cm thick which has a refractive index of 1.50. What fraction of light is absorbed by the glass as the light passes between the surfaces of the plate? (Hint: $\alpha=0.03 \text{ cm}^{-1}$) (20%)
6. 假設銀的格子點數有 $N=10^{23} \text{ (cm}^{-3}\text{)}$ ，且其Schottky型缺陷生成energy為 $E_s=1.09\text{eV}$ ，試求銀在 17°C 以及其融點 960.5°C 時的Schottky型缺陷數以及缺陷數與格子點數的比值 (n/N) 。(20%)

46

