

國立臺北科技大學 104 學年度碩士班招生考試

系所組別：3722 分子科學與工程系有機高分子碩士班乙組

第三節材料科學與工程試題（選考）

第一頁 共一頁

注意事項：

1. 本試題共八題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

一. Explain following term (give examples): 【12%, 每小題 6 分】

1. Heterogeneous nucleation
2. Brittle fracture

二. 【14%, 每小題 7 分】

A boron-doped silicon wafer has an electrical resistivity of $5.00 \times 10^{-4} \Omega \cdot \text{cm}$ at 27°C . Assume intrinsic carrier mobilities and complete ionization.

(a) What is the majority-carrier concentration (carriers per cubic centimeter)?

(b) What is the ratio of boron to silicon atoms in this material?

[Assume $\mu_n = 0.1350 \text{ m}^2/(\text{V} \cdot \text{s})$, $\mu_p = 0.048 \text{ m}^2/(\text{V} \cdot \text{s})$. Density of Si is 2.33 g/cm^3 , Atomic weight of Si is 28.09 g/mol]

三. 【14%, 每小題 7 分】

(a) Determine the Miller indices of the cubic crystal plane that intersects the following position coordinates: $(1, 0, 0)$; $(0, 0, 1/2)$; $(1/2, 1/4, 0)$.

(b) What is the interplanar spacing between parallel closest planes for the above cubic crystal plane with lattice constant of a ?

四. 【11%】

For metal with cubic crystal structure, how to use x-ray diffraction data to distinguish between BCC and FCC crystal structure? Derive the equations and explain them.

五. 【12%】

There are two main mechanisms of diffusion of atoms in a crystalline lattice. Describe (give an example) and explain these two mechanism, respectively.

六. 【10%】

If it takes 115 h to 50 percent recrystallize an 1100-H18 aluminum alloy sheet at 250°C and 10 h at 285°C, calculate the activation energy in kilojoules per mole for this process. Assume an Arrhenius-type rate behavior.

七. 【16%, 每小題8分】

A stress of 75 MPa is applied in the $[0\ 01]$ direction on an FCC single crystal. Calculate (a) the resolved shear stress acting on the $(111) [\bar{1}\ 01]$ slip system and, (b) the resolved shear stress acting on the $(111) [\bar{1}\bar{1}0]$ slip system.

八. 【11%】

Phosphorus is diffused into a thick slice of silicon with no previous phosphorus in it at a temperature of 1100°C. If the surface concentration of the phosphorus is 1×10^{18} atoms/cm³ and its concentration at 1 m is 1×10^{15} atoms/cm³, how long must the diffusion time be?
 $D = 3.0 \times 10^{-13}$ cm²/s for P diffusing in Si at 1100°C.

z	$\text{erf } z$
2.2	0.9981
2.4	0.9993