國立臺北科技大學 103 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）

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 (use graph): 【12%, 每小題 6 分】

1. Schmid's law

2. Bragg's law

二. 【16%, 每小題 8 分】

A silicon wafer is doped with $2.50 \cdot 10^{16}$ boron atoms/cm^3 plus $1.60 \cdot 10^{16}$ phosphorus atoms/cm^3 at 27°C.

Calculate (*a*) the electron and hole concentrations (carriers per cubic centimeter),
and (*b*) the electrical resistivity of the material. [assume at 27°C: $\mu_n = 850$cm^2/(V $\cdot$ s); $\mu_p = 250$cm^2/(V $\cdot$ s); $n_i = 1.5 \cdot 10^{10}$ cm^{-3} .]

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); (1,1/2,1/4); (1/2,1/2,0).

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

四. 【14%】

A large flat plate is subjected to constant-amplitude uniaxial cyclic tensile and compressive stresses of 100 and 20MPa, respectively. If before testing, the largest surface crack is 0.5mm and the plain-strain fracture toughness (K_{IC}) of the plate is 55 MPa $\sqrt{m}$, estimate the final crack size and fatigue life of the plate in cycles to failure. Assume $Y = 1$ in the fracture toughness equation.

For the plate, da/dN (m/cycle) $= 5.0 \cdot 10^{-11} \triangle K^3$ (MPa $\sqrt{m}$)^3

五. 【12%】

There are two methods for strengthening polycrystalline metals. Describe (or give an example) and explain the mechanism of these 2 methods, respectively.

六. 【10%】

Calculate the equilibrium concentration of vacancies per cubic meter in pure silver at 750°C. Assume that the energy of formation of a vacancy in pure silver is 1.10 eV. Assume $C = 1$. Atom mass of silver is 107.87 g/at. Mass. Density of silver is 10.5 Mg/m^3

$k = 8.62 \times 10^{-5}$ eV/K

七. 【12%】

Titanium goes through a polymorphic change from BCC to HCP crystal structure upon cooling through 332°C. Calculate the percentage change in volume when the crystal structure changes from BCC to HCP. The lattice constant a of the BCC unit cell at 882°C is 0.332 nm, and the HCP unit cell has $a = 0.2950$ nm and $c = 0.4683$ nm.

八. 【10%】

A photon in a ZnO semiconductor drops from an impurity level at 1.24eV below its conduction band to its valence band. What is the wavelength of the radiation given off by the transition? ZnO has an energy band gap of 3.54eV.

$1 \text{ eV} = 1.6 \cdot 10^{-19}$ J

$h = 6.62 \cdot 10^{-34}$ J $\cdot$ s