

國立臺灣科技大學

八十九學年度碩士班招生考試試題

系所組別：工程技術研究所材料科技學程

科目：材料導論

共 100 分

- Draw a crystallographic (331) plane in cubic unit cell with lattice constant a . [5 分]
 - Determine the interplanar spacing between parallel closest (331) plane. [5 分]
 - The diffraction from {311} planes, by using incoming X-ray with a wavelength $\lambda = 0.1541$ nm, was obtained at $2\theta = 84.52^\circ$. Calculate the lattice constant a of this material. [5 分]
- Calculate the planar atomic density ρ_p on the (110) plane of the α -iron BCC lattice in atoms per square millimeter. The lattice constant of α -iron is 0.287 nm. [10 分]
- Show the variation of resistivity with composition in binary Cu-Ni alloys in a plot of resistivity ρ versus weight percent of nickel. Explain the reason of variation. [10 分]
- Suppose a thermoplastic polymer can be produced in sheet from either by rolling or by continuous casting. In which case would you expect to obtain the higher strength? Explain. [10 分]
- Calculate the wavelength of light required to stimulate Ge ($E_g = 0.67$ eV) into photoconduction. [5 分]
 - Is the photon in above question in the UV, Visible or IR spectrum? [2 分]
 - Suppose a group V element is intentionally added as a dopant. Calculate the value of $E_g - E_d$ (in units of eV) if the slope of the $\ln\sigma$ versus $1/T$ curve is -1700 K in extrinsic region. (σ is conductivity) [5 分]
- Plot a graph of hysteresis loops (flux density versus magnetic field) of a ferromagnetic material at low, medium and high temperature (below its curie temperature). Explain the reason of the temperature effect. [13 分]
- Which alloy element, N or Co is more likely to have a significant effect on the strength of pure BCC Fe? Why? (atomic radii: $r_N = 0.071$ nm, $r_{Co} = 0.125$ nm, $r_{Fe} = 0.124$ nm) [10 分]
- Explain how optical fibers act as waveguides for the light signals in optical communication. [5 分]
 - How do GeO_2 and F affect the refractive index of the silica glass? [5 分]
- What is the color of pure Al_2O_3 crystal and Al_2O_3 tooth replacement? Why? [10 分]

CONSTANTS

Avogadro's number	$6.02 \times 10^{23} \text{ mole}^{-1}$
Gas Constant	8.314 J/(mole-K)
Boltzmann's constant	$8.62 \times 10^{-5} \text{ eV/K}$
Plank's constant	$6.626 \times 10^{-34} \text{ J-s}$
Speed of light (vacuum)	$2.998 \times 10^8 \text{ m/s}$
Electron charge	$1.602 \times 10^{-19} \text{ C}$

