

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：材料科技研究所碩士班

科目：材料導論

「總分 100 分」

1. The ionization energy of the hydrogen atom is 13.6 eV. What are the frequency and wavelength of the photon emitted from a hydrogen atom when an electron makes a transition from principal quantum number $n=4$ to the lower level $n=1$? [15 分]
2. Nickel has a face-centered cubic structure with lattice constant $a_0 = 0.352$ nm. A powder sample is irradiated with X-ray with a wavelength of 0.1542 nm. What angles (2θ) would the diffracted beams from the (111) and (220) planes make with the incident beam direction? [15 分]
3. A total of 9 mol% Y_2O_3 is mixed with 91 mol% ZrO_2 and heated until a uniform crystal with high oxygen ion conductivity is obtained. What defects will form in this crystal with the formula $Y_xZr_yO_z$? Determine x , y and z . [10 分]
4. Magnesium oxide MgO is a ceramic with the same type of crystalline structure as sodium chloride NaCl. Calculate the lattice constant a_0 and theoretical density ρ ($g \cdot cm^{-3}$) of MgO. (Ionic radii of Mg^{2+} and O^{2-} are 0.065 nm and 0.14 nm, respectively. Atomic weight of Mg and O are 24.3 and 16 $g \cdot mol^{-1}$.) [15 分]
5. A gold-copper solid solution $AuCu_3$ exhibits a disorder-order transformation at 390 °C. Two $AuCu_3$ samples are rapidly quenched and slowly cooled, respectively. Plot variation of electrical resistivity with temperature (0~500 °C) for these two $AuCu_3$ samples. [10 分]
6. Compare dielectric constants of polyethylene (PE), lithium fluoride (LiF) and silica (SiO_2). Explain why their dielectric constants are different. [10 分]
7. Draw (a) a p-n junction diode, (b) its electrical schematic symbol and (c) its terminal polarity at forward bias. [15 分]
8. Compare structure of graphite, carbon nanotubes and C_{60} . [10 分]

Fundamental physical constants and conversions

Quantity	Symbol	Value with units
Speed of light in vacuum	c	$3 \times 10^8 \text{ m} \cdot \text{s}^{-1}$
Planck's constant	h	$6.63 \times 10^{-34} \text{ J} \cdot \text{s}$
Avogadro constant	N_A	$6.02 \times 10^{23} \text{ mol}^{-1}$
Molar gas constant	R	$8.31 \text{ J} \cdot \text{K}^{-1} \cdot \text{mol}^{-1}$
Boltzmann constant, R/N_A	k	$1.38 \times 10^{-23} \text{ J} \cdot \text{K}^{-1}$
1 eV		$1.6 \times 10^{-19} \text{ J}$

