

逢甲大學104學年度碩士班考試入學試題

編號：029 科目代碼：215

科目	材料科學導論	適用系所	材料科學與工程學系	時間	100 分鐘
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※請務必在答案卷作答區內作答。 共 1 頁 第 1 頁

1. Draw a typical creep curve for a metal under constant load and at a relatively high temperature, and indicate on it all three stages of creep (10%)
2. Rank the magnitudes of the diffusion coefficients from greatest to least for the following systems (10%)
(a) *N in Fe at 700 °C* (b) *Cr in Fe at 700 °C* (c) *N in Fe at 900 °C* (d) *Cr in Fe at 900 °C*
3. A sample of BCC metal was placed in an X-ray diffractometer using X-rays with a wavelength of $\lambda = 0.1541$ nm. Diffraction from the {221} planes was obtained at $2\theta = 88.838^\circ$. Calculate a value for the lattice constant a for this BCC elemental metal. (Assume first-order diffraction, $n = 1$.) (10%)
4. Calculate the fraction of atom sites that are vacant for lead at its melting temperature of 327°C (600K). Assume an energy for vacancy formation of 0.52 eV/atom. (hint: Boltzmann constant = 8.6×10^{-5} eV/K; Vacancy fraction = $\exp(-Q/kT)$) (10%)
5. The following electrical characteristics have been determined for both intrinsic and p-type extrinsic indium phosphide (InP) at room temperature. Calculate electron and hole mobilities. (20%)

	$\sigma (\Omega \cdot m)^{-1}$	$n (m^{-3})$	$p (m^{-3})$
Intrinsic	2.5×10^{-6}	3.0×10^{13}	3.0×10^{13}
Extrinsic (n-type)	3.6×10^{-5}	4.5×10^{14}	2.0×10^{12}

6. Copper has a face-centered cubic structure; its lattice constant is 0.361 nm. (a) Calculate the linear density of atoms along the [111] direction. (b) Calculate the planar density of atoms in the (111) plane (10%)
7. A liquid copper quenched instantaneously to a given temperature below the melting point (1085°C) will be solidified and exhibits a 'knee-shaped' transformation curve. This plot is commonly termed as temperature-time-transformation (TTT) diagram. (a) Plot the TTT diagram, and mark the phase regions. (b) Explain why the shape is knee-shaped and there is an optimum temperature for the fastest transformation rate. (20%)
8. Plot the curves of the Fermi function of a metal at 0K and room temperature (298K). You have to (a) mark the coordinates (座標) of the X and Y axes and (b) briefly explain the features of the two curves. (10%)