

國立高雄應用科技大學  
106 學年度研究所碩士班招生考試  
化學工程與材料工程系碩士班  
材料科學

試題 共 2 頁，第 1 頁

注意：a.本試題共 5 題，共 100 分

b.作答時不必抄題

c.考生作答前請詳閱答案卷之考生注意事項

d.可使用計算機。

1. 請回答下面關於體心立方(body-centered cubic, BCC)與面心立方(face-centered cubic, FCC)的問題：
  - (a) 請寫出 BCC 與 FCC 的晶格常數(lattice constant)與原子半徑(atomic radius)間的關係。 (10%)
  - (b) 請計算 BCC 與 FCC 的原子堆積因子(atomic packing factor, APF)。 (10%)
2. 請計算 BCC 與 FCC 之(100)的平面密度(planer density)。 (10%)
3. 請寫出金屬材料(metals)與陶瓷材料(ceramics)中的點缺陷(point defects)種類。 (10%)
4. X-ray diffraction methods are the most important tools for materials scientists/engineers. Please answer the following questions.
  - (a) Write the Bragg's diffraction equation and give the name of the each symbol in the equation. (10%)
  - (b) Write the relationship between interplanar spacing (or called the d-spacing) and the lattice constant (or called lattice parameter) for a cubic structure system and give the name of the each symbol in the equation. (10%)
  - (c) Tungsten has a BCC structure, the diffraction angle of {200} plane is observed at  $2\theta=58.260^\circ$ . Calculate the lattice constant of tungsten (Assume first-order diffraction with  $n=1$  and the wavelength of incident X-ray source is 0.154 nm). (10%)
  - (d) Calculate the atomic radius of the tungsten. (10%)
5. A piece of the plain steel with a nominal carbon content of 0.20 wt% was placed in a furnace at  $827^\circ\text{C}$  with a flowing methane ( $\text{CH}_4$ ) gas. Assume that the carbon content at the surface of the steel is maintained at 1.0 wt%. Calculate the time necessary to increase the carbon content to 0.5 wt% at 0.5 mm below the surface. (20%)

【背面尚有試題】

**Data:** The diffusion coefficient of carbon in FCC iron

$$D=2.0 \times 10^{-5} \exp(-142000 / RT)$$

where D is the diffusion coefficient ( $\text{m}^2/\text{s}$ ), R is the gas constant ( $8.314 \text{ J/mol}\cdot\text{K}$ ), and T is the absolute temperature (K).

**Table 1** Table of the error function

<b>z</b>	<b>erf(z)</b>	<b>z</b>	<b>erf(z)</b>	<b>z</b>	<b>erf(z)</b>
0.00	0.0000	0.55	0.5633	1.10	0.8802
0.025	0.0282	0.60	0.6039	1.20	0.9103
0.05	0.0564	0.65	0.6420	1.30	0.9340
0.10	0.1125	0.70	0.6778	1.40	0.9523
0.15	0.1680	0.75	0.7112	1.50	0.9661
0.20	0.2227	0.80	0.7421		
0.25	0.2763	0.85	0.7707		
0.30	0.3286	0.90	0.7970		
0.35	0.3794	0.95	0.8209		
0.40	0.4284	1.00	0.8427		
0.45	0.4755				
0.50	0.5205				

【以下空白】