

國 立 清 華 大 學 命 題 紙

九十三年學年度 工程與系統科學 系(所) 甲 組碩士班入學考試

科目 物理冶金 科號 3801 共 二 頁第 一 頁 *請在試卷【答案卷】內作答

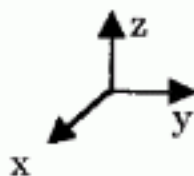
1) 9% a) For a tetragonal unit cell, list all planes or directions that fall into the following classes:

$\langle 110 \rangle$, $\{110\}$, $\langle 101 \rangle$, $\{101\}$

8% b) In this same structure, what would the value of c/a need to be for (101) and $(\bar{1}01)$ to be orthogonal? Prove your answer.

8% c) Sketch the following within a tetragonal unit cell with $c/a > 1$: $(\bar{2}10)$, $(\bar{1}23)$

For clarity, use a separate sketch for each plane or direction. Clearly label (as a fraction of c or a , as applicable) the intercepts with the crystallographic axes. Position the three axes as shown.



2) 10% a) Calculate the c/a ratio for an ideal hexagonal close packed structure.

15% b) Calculate the size (as a fraction of the diameter of the parent metal atoms) of the largest interstitial solute atom that can fit into a) fcc metal and b) bcc metal without distorting the parent lattice. Hint: consider both the octahedral and tetrahedral sites.

3) Consider a dislocation in an FCC crystal with the following characteristics: $\tau_{cr} = 0.5 \text{ Mpa}$ (τ_{cr} is critical resolved shear stress), $n = a/\sqrt{6}$ $[\bar{1}\bar{1}2]$ (line direction of dislocation) and $b = (a/2)[\bar{1}10]$ (Burgers vector of dislocation)

9% a) Determine the slip plane for this dislocation.

8% b) Calculate the magnitude of the applied normal stress in the (010) direction necessary to cause motion of this dislocation.

8% c) Repeat part (b) for a normal stress applied in the (001) direction.

4) A binary alloy contains element A and B. The melting temperature of A is lower than B. The mutual solubility of these two elements is almost zero. These two elements form an intermetallic compound A_3B . A- A_3B and B- A_3B form eutectic type of phase diagram. (hint: the melting temperature of A_3B is the highest among A, B and A_3B)

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- 10% a) please draw phase diagram for this binary alloys. Please mark clearly all the eutetic temperatures and the composition.
- 15% Please draw the G (Gibbs free energy)-x%(composition) curve for
- b) the temperature above melting temperature of B but lower than that of A_3B
 - c) the temperature above melting temperature of A but lower than that of B
 - d) lower than all the eutetic temperatures of $A-A_3B$ and $B-A_3B$