逢甲大學101學年度碩士班招生考試試題 編號：047 科目代碼：

科目	材料科學導論	適用系所	材料科學與工程學系	時間	120 分鐘

※請務必在答案卷作答區內作答。

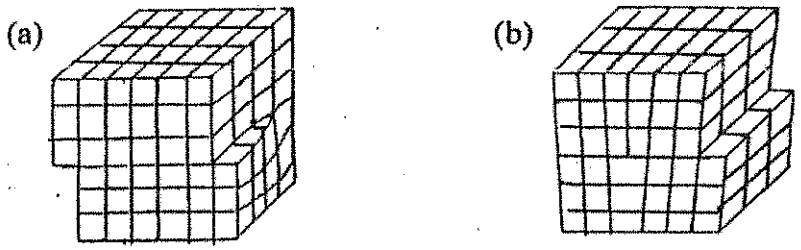
1. Explain: (5% each)

   (a) Bravais lattices; (b) Twin boundary; (c) Critical resolved shear stress; (d) Strain hardening.

2. Calculate the linear densities in the [100], [110] directions and planar densities in the (100), (110) planes in FCC structure. (10%) (b) Evaluate the atomic packing factor (APF) for diamond structure. (10%)

3. Please derive the Bragg law? (5%) (b) Explain why an X-ray diffraction pattern of crystalline powders consists of many sharp peaks but an XRD pattern of noncrystalline powders shows only two or three very diffuse bumps. (15%)

4. (a) For the complete miscibility to occur in metallic solid solutions, the two metals must be quite similar, as defined by the Hume-Rothrry rules. What are the the Hume-Rothrry rules? (12%) (b) What type of dislocation in figure (a) and (b)? (4%) (c) The direction of along which dislocation moves is parallel or perpendicular to the direction of Burgers vector in each case. (4%)



5. (a) Explain the difference between selfdiffusion and interdiffusion of solids. (8%) (b) Wrire down the equations for Fick's first and Fick's second laws of diffusion, and explain the variables and ssumptions for the equation. (12%)

6. A liquid quenched instantaneously (瞬間地被淬火) to a given temperature (T_t) below the melting point will be solidified and exhibit a "knee shaped" transformation curve. Such plot is termed as Time-Temperatrure-Transformation (TTT) curve. (a) Plot a typical TTT curve and explain the features (特徵) of this curve. (10%) (b) From the point view of nucleation theory to explain why there is an optimum temperature for nucleation to occur. (10%)

7. Classical theory of "homogeneous nucleation" for solidification of a liquid is based on an energy balance between the precipitates and its surrounding liquid. This theory generally assumes that (1) the precipitate shape is sphere with a radius of r (半徑 = r) and (2) surface energy and volume energy are involved. (a) Write down the equation for surface energy variation and volume energy variation. (8%) (b) Plot the above (surface energy variation and volume energy variation) curves and net energy-variation curve, and point out the positions of critical size and energy barrier. (6%) (c) Briefly explain the classical theory of "homogeneous nucleation" according to the net energy-variation curve. (6%)

8. Al-Cu can be strengthened by precipitation hardening. Explain the procedure of precipitation-hardened Al-Cu alloys. (20%)

9. (a) Plot the energy band diagram of a sodium (Na) solid (必須繪出valence band, conduction band 以及電子填充狀況)，also use the energy band model to explain why sodium solid is a conductor material。(8%) (b) Plot the curves of the Fermi function of a metal at 0K and room temperature (298K) (繪畫一金屬在 0K與298K的 Fermi function曲線，並要標示X軸及Y軸座標). (6%) (c) What is the probability of an electron being thermally promoted to the conduction band in diamond (E_g = 5.6 eV) at 298K? (6%)

Fermi function: $$f(E) = \frac{1}{e^{(E-E_F)/kT}+1}$$

10. Refer to the ZrO_2-CaO phase diagram to answer the questions. (a) Why pure ZrO_2 is useless? (10%) (b) ZrO_2 can become useful by adding 20 mol% of CaO. Why? (10%)