國立臺灣科技大學

九十一學年度碩士班招生考試試題

系所組別： 工程技術研究所材料科技學程

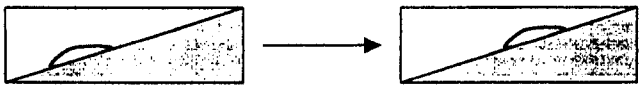
科　目： 材料導論

共 100 分

1. The sodium chloride (rock salt) structure consists of Cl^- anions in a f.c.c. array, with Na^+ cations occupying the octahedral interstitial sites. Assume the radii of Cl^- anion and Na^+ cations are 2 Å and 1 Å.
   (a) Draw the atom locations on the (100) plane of the NaCl crystal. [5 分]
   (b) Calculate the packing factor (%) of the NaCl crystal. [5 分]
   (c) List the stacking sequence in the rock salt crystal along its [111] direction? [5 分]

2. A polymer sample was cooled from a viscous melt state to a glassy state.
   (a) How does the volume change after being kept at a temperature just below its glass transition temperature (T_g) for one week? [5 分]
   (b) Is the above reaction endothermic or exothermic? [5 分]
   (c) How does the cooling rate affect the T_g? [5 分]

3. How to let a droplet of water climb up along the surface of a tilted material? [12 分]



4. (a) Why can a blue laser offer greater data storage density in optical recording media (such as compact disc) than are available from the current generation of infrared lasers? [5 分]
   (b) How to make Si emitting light in visible wavelengths? [5 分]

5. (a) Corrosion happened in a bent iron tube (L-shape). Plot a schematic diagram of the iron tube and mark the cathode and anode areas of this tube. [5 分]
   (b) Can the iron (Fe) tube be protected against corrosion by attaching it to a piece of aluminum (Al) or platinum (Pt) ? [5 分]

6. The equilibrium phase diagram of copper-nickel system is isomorphous. The melting points of copper (Cu) and nickel (Ni) are 1083 ^{o}C and 1452 ^{o}C, respectively.
   (a) A Cu-40%Ni is slowly cooled down from liquid to solid. Draw its final structure. [5 分]
   (b) A Cu-40%Ni is rapidly cooled down from liquid to solid and forms dendrites. Draw its final structure. Also draw the Ni concentration profile across the dendrite and its surrounding materials. [10 分]

7. (a) Plot the band diagram of a solar cell consisting of a p-n junction. Indicate the motion directions of charge carriers and the direction of electric field on the diagram. [8 分]
   (b) Plot the current-voltage characteristics (I-V curve) of a solar cell with and without absorbing sunlight. [7 分]

8. Plot the stress-strain curves of a thermoplastic polymer at 4 ^{o}C, 25 ^{o}C and 60 ^{o}C. (Assume T_g of this polymer is 100 ^{o}C.) [8 分]