國立臺灣大學九十三學年度轉學生入學考試試題

科目： 材料科學導論

題號：24

共 2 頁之第 1 頁

1. Derive the planar density expression for FCC(100) plane in terms of the atomic radius R. (5%)
2. Briefly describes a twin and a twin boundary. (5%)
3. For the diffusion of hydrogen, carbon and manganese atoms in mild steels, which one has the highest diffusivity? Why? (5%)
4. Cite and explain the materials properties measured for a metal subjected to tensile test. (5%)
5. Consider a single crystal of silver oriented such that a tensile stress is applied along a [010] direction. If slip occurs on a (111) plane and in a $[1\,\bar{1}\,0]$ direction, and is initiated at an applied tensile stress of 1.1 MPa, compute the critical resolved shear stress. (5%)
6. Briefly cite the differences between recovery and recrystallization processes. (5%)
7. Briefly compare the fractography of a ductile polycrystalline material subjected to tensile and fatigue tests, respectively. (5%)
8. Figure 1 shows a schematic representation of the TTT diagram for eutectoid steel. What is the microstructure of a eutectoid plain carbon steel isothermally annealed at temperature $T_2$? (5%)

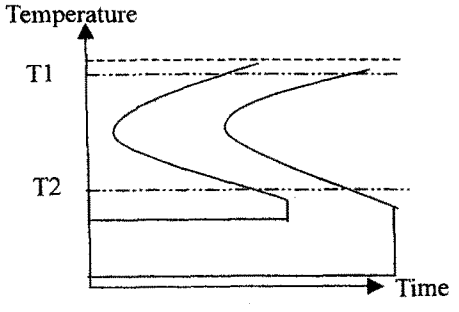


Figure 1

9. Outline a complete program for obtaining a maximum hardness associated with an Al-Cu alloy with the composition close to Al-rich end. (5%)
10. Cite two reasons why martensite is so hard and brittle. (5%)
11. Draw a photomicrograph (cross-polarized light microscope) of spherulite structure of polyethylene schematically. (5%) Explain what kind of the structure it is to result in the pattern in the photomicrograph. (5%)
12. What is the nematic type of liquid crystal polymers? (5%) Draw the structure of nematic type of liquid crystal polymers schematically.

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(5%) Why is the melt viscosity of nematic type of liquid crystal polymers relatively low? (10%)

3. Recently developed toughening techniques involve the utilization of ceramic whiskers, often SiC or $Si_3N_4$. These whiskers may inhibit crack propagation by several mechanisms. Cite two of them. (10%)

4. Iron titanate, $FeTiO_3$, forms in the ilmenite crystal structure that consists of an HCP arrangement of $O^{2-}$ ions. (a) Which type of interstitial site will the $Ti^{4+}$ ions occupy? Why? (5%) (b) What fraction of the total tetrahedral sites will be occupied? (5%) (Ionic radii for $Fe^{2+}$, $Ti^{4+}$, and $O^{2-}$ are 0.077, 0.061, and 0.140 nm, respectively)