國立臺灣大學 102 學年度碩士班招生考試試題

1. The phenomena of recovery, recrystallization and grain growth may occur during annealing treatment of a cold-worked brass alloy.
   (a) Draw schematically the variation of tensile strength and ductility during the stages of recovery, recrystallization and grain growth for a cold-worked brass alloy. (3%)
   (b) Demonstrate the driving forces for recrystallization and grain growth. (4%)
   (c) Demonstrate briefly the phenomenon of "polygonization" during the recovery process. (3%)

2. For a diffusional phase transformation,
   (a) Draw the so-called C curve (temperature versus logarithm time to some degree of transformation) and S curve (fraction transformed versus the logarithm of time) for the transformation. (4%)
   (b) Explain the meanings of these C curve and S curve. (6%)

3. For the precipitation in aluminum- 4% copper alloy,
   (a) Demonstrate briefly the processes of T4 and T6 heat treatment. (4%)
   (b) Draw and discuss the curves of hardness versus aging time for this alloy aged at room temperature, 130°C, and 190°C, respectively. (6%)

4. An engineering component made of S-590 alloy is subjected to creep under simple tension at a stress of 150 MPa. What is the highest temperature that can be permitted if the component must function for 400 days? The same material was subjected to creep in a test at 150 MPa and at 530°C, in which it ruptures in 260 hours. (10%)
   Using the Larson-Miller parameter, $P_{LM} = T(\log t_r + C)$
   t_r : time to rupture, $C = 20$.

5. What is the block copolymer? (5%) What is the thermosetting polymer? (5%)

6. What is the crazing? (5%) What is the difference between a craze and a crack? (5%)

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7. (10%) The electrical conductivity and the electron mobility for "metal A" are 6.0×10^7 $(\Omega \cdot m)^{-1}$ and 0.003 $m^2/V \cdot s$, respectively. (a) Compute the number of free electrons per cubic meter for "metal A". (b) What is the number of free electrons per "metal A" atom? (Assume a density of "metal A" is 10 g/cm^3, and the atomic weight value for "metal A" is 70 g/mol).

8. (10%) What are transparent conducting films? Please describe and compare some kinds of materials for preparing transparent conducting films.

9. (10%) Give an example of a ceramic material (product) that has a low Weibull modulus. Explain the relationship among the processing, application, and low Weibull modulus of this ceramic material (product).

10. (10%) Consider two hypothetical ceramic compounds MX and MX_2 with $\frac{r_c}{r_a}$ values of 0.3 and 0.5, respectively. What possible structures can either of them adopt? (Here, M represents the cation, X represents the anion, and $\frac{r_c}{r_a}$ is the cation/anion radius ratio.)

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