※ 注意：請於試卷內之「非選擇題作答區」依序作答，並應註明作答之大題及小題題號。

1. Draw a hexagonal unit cell and sketch within this unit cell the $(\bar{1}\,\bar{1}\,22)$ plane and $[2\bar{1}\,\bar{1}\,0]$ direction. (10 分)
2. Compare the glide motion and climb motion of an edge dislocation. (8 分)
3. Cite one similarity and two differences between precipitation hardening and dispersion strengthening. (7 分)
4. The Fick's first law and Fick's second law of diffusion are expressed as

$J = -D\frac{dC}{dx}$ Fick's first law $\quad \frac{\partial C}{\partial t} = D\frac{\partial^2 C}{\partial x^2}$ Fick's second law, $C$ is the concentration of the diffusion species.

(1) Which equation can be employed to calculate the concentration as a function of diffusion time and position of a carbon steel subjected to carburization treatment? Why? (5 分)

(2) Briefly discuss the factors that influence the magnitude of diffusion coefficient. (5 分)

5. Among FCC, BCC, and HCP metals

(1) Briefly explain why HCP metals are typically more brittle than FCC and BCC metals. (5 分)

(2) Briefly explain why BCC metals generally display a more obvious ductile-to-brittle transition behavior than FCC and HCP metals. (5 分)

6. Figure 1 shows the percent recrystallization as a function of time and at constant temperature for pure copper.

(1) Why each percent recrystallized vs. time plot usually shows up as a sigmoid curve? (5 分)

(2) Why the percent recrystallization remains to be zero up to a certain period of time at constant temperature? (5 分)

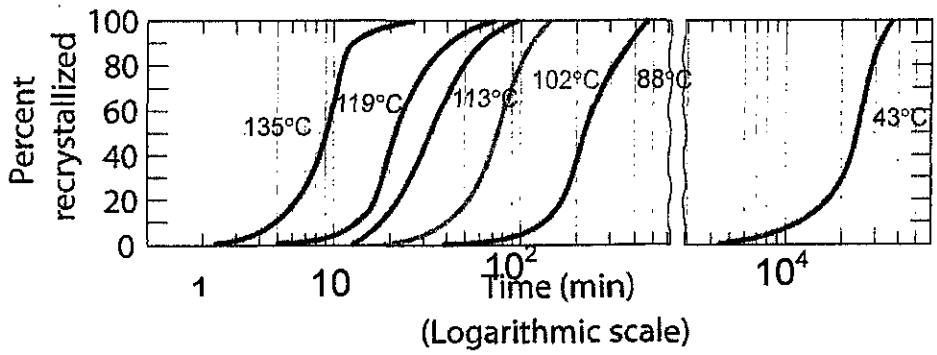


Figure 1

見背面

7. About heat treatment of steels

(1) Briefly explain the difference between hardness and hardenability. (5 分)

(2) How would you expect a decrease in the austenite grain size to affect the hardneability of an alloy steel? Why? (5 分)

8. Figure 2 shows the phase diagram for the MgO-$Al_2O_3$ system. Determine the type of vacancy defect that is produced and the percentage of vacancies that exist in the spinel phase ($MgAl_2O_4$) composed of 92 wt% (weight percentage) $Al_2O_3$ and 8 wt% MgO at 2000°C. (10 分)

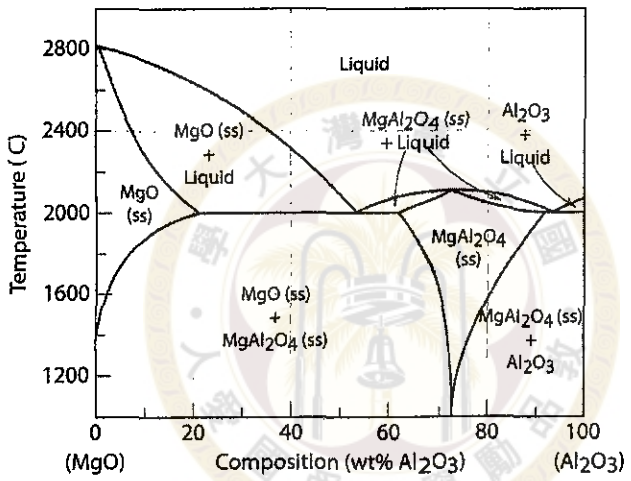


Figure 2

9. Crosslinked copolymers consisting of 35 wt% ethylene and 65 wt% propylene may have elastic properties similar to those for natural rubber. For a copolymer of this composition, determine the fraction of both repeat unit types. Note the atomic weight of hydrogen and carbon is 1 and 12 g/mole, respectively. (7 分)

10. Would you expect the tensile strength of polychlorotrifluoroethylene to be greater than, the same as, or less than that of polytetrafluoroethylene specimen having the same molecular weight and degree of crystallinity? Why? (8 分)

11. For each of the following pairs of semiconductors, decide which will have the smaller band gap energy, $E_g$, and then cite the reason for your choice. (10 分)

(1) AlP and InSb.

(2) ZnSe and CdTe.

**試題隨卷繳回**