

國立臺灣大學九十五學年度轉學生入學考試試題

題號：39

科目：材料科學導論

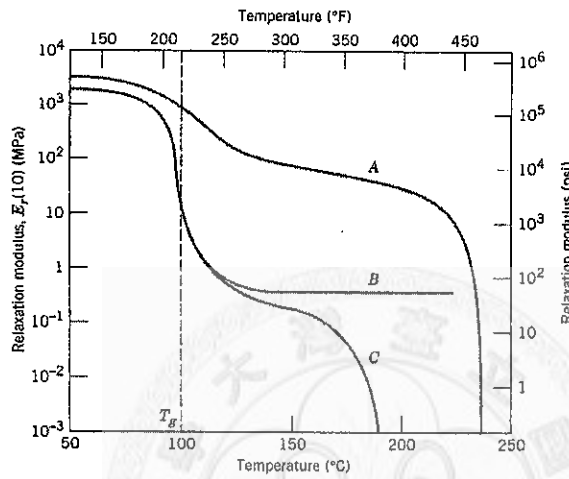
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1. Which type of diffusion do you think will be easier (have a lower activation energy)? (a) C in HCP Ti, (b) N in BCC Ti, and (c) Ti in BCC Ti. Explain your choice. (5%)
2. List three ways in which a metal can be strengthened by hindering the motion of dislocations. Discuss these strengthening mechanisms from a physical point of view and indicate whether or not the indicated mechanism would be strongly temperature-dependent. (10%)
3. The binary system A-B with $T_B > T_A$ (where T_A and T_B are the melting temperature of component A and B, respectively) is known to contain two invariant reactions of the type:
$$L \rightarrow \alpha + \beta \text{ at } T_1$$
$$L \rightarrow \beta + \gamma \text{ at } T_2$$

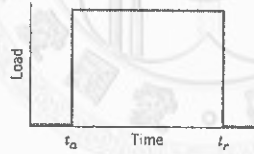
where $T_1 < T_A$ and $T_2 > T_A$. If β ($0.5A + 0.5B$) is a congruently melting phase at temperature higher than T_B , sketch a possible phase diagram. (5%)
4. Compare and contrast the glide (slip) and climb motions of an edge dislocation. (5%)
5. During annealing of a cold-worked metal, what is the driving force for recrystallization and grain growth, respectively? (5%)
6. Briefly cite the differences between pearlite, bainite, and spheroidite relative to microstructure and mechanical properties. (5%)
7. Suppose that Li_2O is added as an impurity to CaO . If the Li^+ substitutes for Ca^{2+} , what kind of vacancies would you expect to form? How many of these vacancies are created for every Li^+ added? (5%)
8. Why the fracture strength for some given ceramic materials increases with decreasing specimen size? (5%)
9. For refractory ceramic materials, cite three characteristics that improve with and two characteristics that are adversely affected by increasing porosity. (5%)
10. Explain the following three types of magnetism: (a) diamagnetism, (b) paramagnetism, (c) ferromagnetism. (9%)
11. Sketch an H vs B curve to show the hysteresis behavior of a typical ferromagnetic material. Explain the mechanism behind the hysteresis behavior. (5%)
12. Explain the basic principle of lasers. (6%)
13. A common use of the p-n-p junction transistor is for voltage amplification. Explain the mechanism behind this voltage amplification. (6%)
14. Consider a pure silicon (Si) sample and a Si sample doped with $10^{21}/\text{m}^3$ of phosphor (P). What will the electron concentration versus temperature plot of these two samples look like? Sketch a simple drawing to illustrate your answer. (6%)

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15. Consider three types of polystyrene (PS): crosslinked atactic, non-crosslinked atactic, and non-crosslinked isotactic. Match each of these three types of PS to one of the curves given below. Explain your answers. (9%)



16. A standard specimen for tensile testing is applied a constant tensile load for a period between t_a and t_r , as illustrated below:



- Sketch a simple drawing to show the strain-versus-time relationship if the specimen is (a) totally viscous, (b) totally elastic, and (c) viscoelastic (9%)

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