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| 招生學年度 | 100 | 招生類別 | 碩士班 |
| 系所班別 | 材料科學與工程學系碩士班 | | |
| 科目 | 材料科學與工程 | | |
| 注意事項 | 本考科可使用掌上型計算機 | | |

1. Consider diamond, copper, and H₂O.
 - (a) State the type of bonding expected for each of the three types of materials. (5%)
 - (b) Rank the bonding energies from each of these types of bonds from strongest to weakest. (5%)
2. An elastomer is a polymer with the property of elasticity.
 - (a) Explain why an elastomer has to have a lightly cross-linked molecular chain structure? (5%)
 - (b) Are elastomers typically crystalline, semi-crystalline or non-crystalline? Why? (5%)
 - (c) A typical rubber band is made of an elastomer. Is room temperature below, above or approximately equal to its glass transition temperature? Why? (5%)
3.
 - (a) Explain why semiconductors are electrically conductive. Give examples using band diagrams. (5%)
 - (b) How does their conductivity change as a function of temperature? Why? (5%)
4. The property that characterizes the ability of a material to transfer heat is the thermal conductivity.
 - (a) Describe the mechanisms which influence the thermal conductivity in an ideal pure metal. (10%)
 - (b) For a single crystal specimen and a polycrystalline one of the same material. Do you expect different thermal conductivities? Why? (5%)
5.
 - (a) Explain the reason why cold working makes a metal sample harder, and why annealing would make it go back to the softer state. (10%)
 - (b) Do you expect the same kind of effects for typical ceramic materials? Briefly explain your answer? (10%)
6. Diffusion is an important process in the solids.
 - (a) Briefly explain the difference between self-diffusion and inter-diffusion. (10%)
 - (b) The diffusion coefficients for carbon in nickel are: $5.5 \times 10^{-14} \text{ m}^2/\text{s}$ at 600°C, and $3.9 \times 10^{-13} \text{ m}^2/\text{s}$ at 700°C. Calculate the diffusion coefficient at 780°C assuming the same diffusion mechanism operates. (Gas constant $R = 8.314 \text{ J/mol-K}$.) (10%)
7. Describe the characterization techniques that might be useful in differentiating among different phase structures. (10%)