國立台灣科技大學九十八學年度碩士班招生試題

系所組別： 高分子工程系碩士班丙組

科　　目： 材料導論

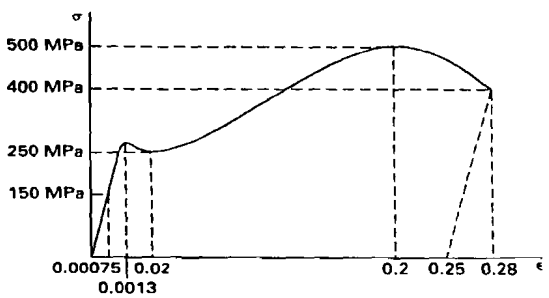
材料導論；共 8 大題，總分 100 分；請於答案卷內依序作答。

1. Draw the energy band structures for rectifying contact between a metal and n-type semiconductor (a) before and (b) after contact is made. Indicate work functions, energy levels and energy barriers in your drawing. [10 points]
2. Calculate the average thermal velocity, the mobility, and the drift velocity of copper in an electric field of 100 V/m. The resistivity of copper is 1.72×10^{-8} Ω m at 25 °C. The density and molar weight of copper are 8.9×10^{3} kg/m^3 and 63.54×10^{-3} kg/mol, respectively. (Boltzmann constant k : 1.38×10^{-23} J/K; Avogadro constant: 6.023×10^{23} /mol; mass of electron = 9.11×10^{-31} kg; charge of electron: 1.6×10^{-19} C; J = kg m^2 s^{-2}; Ω =V/A; C=A s) [10 points]
3. How and why does thermal conductivity of a semiconductor change with doping concentration? [10 points]
4. Justify the following statements with your explanations. [5 points for each item]

(a) A minimum amount of deformation of the metal is necessary for "recrystallization" to occur.
(b) The alloys with fine grain structures are suitable for high-temperature uses.
(c) The annealing only occurs at high temperatures, not room temperature.
(d) For metals and alloys, creep only occurs at relatively high temperatures, not room temperature.
(e) Fatigue properties are often affected by the material surface condition such as smoothness.

5. Use the stress-strain curve below for the following questions. [5 points for each item]

(a) What is the ductility of this material? (b) Where does the necking start to form? (c) Does this curve show strain-hardening (work hardening)? If yes, please specify the location.



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6. The diffusion coefficients for copper in aluminum at 500 and 600°C are 4.15×10^{-14} and 4.69×10^{-13} m^2/s, respectively. What time will be required at 500°C to produce the same diffusion result as for 10 h at 600°C? [10 points]

7. Indicate whether the following statements are correct or incorrect and justify your answer: [10 points]

(a) The electron configuration of the copper element (Z=29) is $[Ar]3d^94s^2$ [2 points]

(b) Dislocations cause slip between crystal planes when they move. [2 points]

(c) A typical dislocation density for ceramic materials is 10^9~10^{10} mm^{-2} [3 points]

(d) FCC slip plane is {110} [3 points]

8. In the HCP structure, (a) what is the coordination number for the atoms? [5 points] and (b) how many atoms per unit cell are in the crystal structure? [5 points]