國立臺灣科技大學101學年度碩士班招生試題

系所組別： 機械工程系碩士班戊組

科　　目： 工程材料（一）

（總分為100分）

1. Please define the meanings of (a) self-diffusion and interdiffusion; (b) atomic mechanisms for interstitial diffusion and vacancy diffusion. (10 分)

2. A copper-nickel diffusion couple undergone a 500-h heat treatment at 1000°C (1273 K) was observed the Ni concentration of 3.0 wt% at the 1.0-mm position with the copper. At what temperature should the diffusion couple be heated to produce the same concentration (i.e., 3.0 wt% Ni) at a 2.0-mm position after 500-h? The pre-exponential and activation energy for the diffusion of Ni in Cu are 2.7×10^{-4} m^2/s and 236,000 J/mol, respectively. (10 分)

3. Please describe why the resistivity of manganese is much greater than the resistivity of the other forth period transition elements. (10 分)

4. (a) Please describe the reasons of residual thermal stresses are introduced into a glass piece as it is cooled. (5 分)

   (b) Are thermal stresses introduced upon heating? Why or why not? (5 分)

5. Indium has a tetragonal unit cell for which the a and c lattice parameters are 0.459 and 0.495 nm, respectively.
   (a) If the atomic packing factor and atomic radius are 0.693 and 0.1625 nm, respectively, determine the number of atoms in each unit cell. (5 分)
   (b) The atomic weight of indium is 114.82 g/mol; compute its theoretical density. (5 分)

6. For a concentration cell, briefly explain why corrosion occurs at that region having the lower concentration.(10 分)

7. Please plot the conductivity ty or resistivity *vs* temperature curve schematically for (a) metal (4 分) ; (b) intrinsic semiconductor (3 分) and (c)extrinsic semiconductor. (3 分)

8. A copper wire is stretched with a stress of 70 MPa at 20°C (293 K). If the length is held constant, to what temperature must the wire be heated to reduce the stress to 35 MPa. *E* and α_l for copper are 110 GPa and 17.0×10^{-6} (°C)$^{-1}$, respectively. (10 分)

9. Cite the differences between hard and soft magnetic materials in terms of both hysteresis behavior (5 分) and typical applications. (5 分)

10. The transmissivity T of a transparent material 20 mm thick to normally incident light is 0.85. If the index of refraction of this material is 1.6, compute the thickness of material that will yield a transmissivity of 0.75. All reflection losses should be considered. (10 分)