國立臺灣科技大學 109 學年度碩士班招生試題

系所組別：材料科學與工程系碩士班丙組

科　　目：材料導論

(總分為 100 分)

1.(20%)

(1) Give all the possible phases present in the iron–iron carbide equilibrium phase diagram just above the eutectoid temperature and just below the eutectoid temperature, respectively. What are the name and crystal structure of these phases? (5 %)

(2) Write the equations for the eutectoid reaction and the eutectic reaction for the iron-iron carbide system. (5 %)

(3) Draw and explain the microstructure for an iron–carbon alloy of hypoeutectoid composition that was very slowly cooled down to a temperature below the eutectoid temperature. (5 %)

(4) Compare the yield strength and ductility of plain carbon steel with hypoeutectoid composition and hypereutectoid composition. (5 %)

2. (15%)

(1) Compare the temperature dependence of electrical conductivity and carrier mobility for metals and intrinsic semiconductors. (8 %)

(2) Draw the simplified energy diagram for ruby laser and show the processes for generation of laser photon. (7 %)

3. (15%)

(1) What are the origins of magnetic moments in an atom? What is the Bohr magneton μ_B? (5 %)

(2) Draw the B (magnetic induction) versus H (magnetic field strength) curve for iron at 0 K, at a temperature just below its Curie temperature, and at a temperature just above its Curie temperature on a single plot. (10 %)

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4. **(20%) "Grain size reduction strengthening" and "solid-solution strengthening" are two typical mechanisms for metal strengthening. Please describe the reasons how these mechanisms make the metal materials harder and stronger.**

5. **(15%) (1) Please draw the schematic diagram of typical bonding energy curve for Si and O atoms (please include X axis (Interatomic separation) and Y axis (Potential energy)). And, please label "bonding length" and "bonding energy" using the curve (10 %). (2) Why the amorphous materials exhibit the higher energy than the crystalline materials (5 %).**

6. **(15%) Please calculate (1) the minimum cation-to-anion radius ratio for a coordination number of 4 (tetrahedral) lattice. (5 %) (2) the minimum cation-to-anion radius ratio for a coordination number of 6 (octahedral) lattice (5 %). (3) Please select the material having the coordination number of 4 form KI, NiO or NiS (ionic radii of K^+, I^-, Ni^{2+}, O^{2-}, and S^{2-} are 0.138nm, 0.220nm, 0.069nm, 0.140nm, and 0.184nm, respectively) (5 %).**