國立台灣科技大學一百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)

共十題，每題10分

1. Please define the meaning of semiconductor and explain why the electrical conductivity of semiconductors increase as temperature is increased. Using band theory, explain this observation. (10%)
2. (a) Derive linear density expressions for FCC [100] and [111] directions in terms of the atomic radius R. (6%)
   (b) Compute and compare linear density values for these same two planes for copper. [* The atomic radius for copper is 0.128 nm.] (4%)
3. Fe_3O_4 (FeO-Fe_2O_3) has a cubic symmetry with a unit cell edge length of 0.839 nm. If its density is 5.24 g/cm^3, please compute its atomic packing factor. [*ionic radii: Fe^{2+} = 0.077 nm, Fe^{3+} = 0.069 nm, and O^{2-} = 0.140 nm.] (10%)
4. Please describe what determine the characteristics colors of (a) a metal and (b) a transparent nonmetal. (10%)
5. (a)假設 CaO 被當作雜質添加到 Li_2O 中，若 Ca^{2+}取代 Li^+，請問將會有何種空位會產生？而每個 Ca^{2+}的添加會製作出多少個此類的空位？(5%)
   (b)假設 CaO 被當作雜質添加到 $CaCl_2$ 中，若 O^{2-}取代 Cl^-，請問將會有何種空位會產生？而每個 O^{2-}的添加會製作出多少個此類的空位？(5%)
6. (a) Describe three different types of polarization in materials, and briefly explain the mechanism by which dipoles are induced and/or oriented by the action of an applied electric field. (5%) (b) For solid lead titanate (PbTiO3), gaseous neon, diamond, solid KCl, and liquid NH3. What kid(s) of polarization is (are) possible? Why? (5%)
7. Explain why (a) the thermal conductivities are higher for crystalline than non-crystalline ceramics (5%); (b) metals are typically better thermal conductors than ceramics(5%).
8. What is a "superconductor"? (2%) What is a Meissner effect? (3%) There are two different types of superconducting materials on the basis of magnetic response; can you describe the difference between them? (5%)
9. To design a solid oxide fuel cell, we have to consider polarization behavior in electrodes. Could you (a) describe the major differences between activation and concentration polarizations? (5%) (b) Under what consitionss is concentration rate controlling? (5%)
10. 請用化學式來描述一個金屬的氧化反應與還原反應。請說明陽極與陰極各發生什麼反應？(5%) 運用此觀點，你如何設計一個電鍍製程，將金鍍到線元件上？(5%)