國立臺灣科技大學

九十二學年度碩士班招生考試試題

系所組別：機械工程系碩士班戊組

科　目：　工程材料

以下共十題，每題１０分，共１００分，請依序作答。除了最後答案外，請寫下推理或計算過程。

1. Which of the following intrinsic semiconductors of single crystal are transparent to visible light (400 nm to 700 nm)? Plank's constant = 6.62 X 10^{-34} J·s, speed of light = 3 X 10^{8} m/s, 1 eV = 1.6 X 10^{-19} J.

Material	Energy Gap (eV)
ZnS	3.54
PbS	0.37
InSb	0.17
GaAs	1.35
ZnO	3.20

2. ITO (Indium Tin Oxide) is usually claimed to be a "transparent oxide conductor", which is used in the fabrication of LCD (liquid crystal display) panel. Is it really a conductor, just a semiconductor, or even an insulator? What is the effect of temperature on the electrical conductivity of ITO?
3. Arrange the following materials in the increasing order of melting point. CH_3OH, H_2O, NaCl, MgO, C_2H_6.
4. What is the atomic packing factor (or efficiency) of a body-centered cubic lattice? Tungsten (W), which has a body-centered cubic crystal structure, has an atomic radius of 0.1371 nm and an atomic mass of 183.85 g/mole. What is the theoretical density of tungsten, expressed in the unit of g/cm^3?
5. Titanium (Ti) has a hexagonal close-packed lattice. How many planes are there in the {321} family of planes?
6. Modern electronic devices of high performance involve dissipation of high power. What are the principal thermal properties you have to consider when you are choosing materials for the packaging of Si chips.
7. What is a thermally activated process? Give one example. What can you do to enhance the rate of a thermally activated process?
8. Diamond has the highest thermal conductivity of all materials, but it has a very low electrical conductivity. Please explain this phenomenon.
9. Soft magnetic materials for high frequency applications suffer the problem of temperature rise in use. What are the causes of such a problem? Describe how you can minimize such a problem, in terms of material selection and structure design.
10. Grain growth of alumina (Al_2O_3) at high temperatures becomes very fast if a thin (a few nm) layer of SiO_2-based liquid phase presents between grains. Explain the cause of such an observation.

Transparent: 透光的, fabrication: 製造, dissipation: 散逸出來, in terms of 以-----的角度, enhance: 提高, phenomenon: 現像, suffer: 忍受---痛苦, efficiency:效率