

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：材料科技研究所碩士班

科目：材料導論

[總分 100 分]

1. The thermal expansion coefficient of Pyrex is 5×10^{-6} in./in./°C and the modulus of elasticity of Pyrex is equal to 9×10^6 psi. Assume that we have the Pyrex rod rigidly fixed at both ends. What kind of stress and what magnitude of stress is caused by submerging the room temperature rod (20°C) into boiling water? [10 分]
2. (a) Gallium nitride (GaN) is a wide band gap material (3.4 eV). What color will GaN single crystal appear to be? [5 分]
(b) What color will GaN emit from its band gap emission? [5 分]
(c) How will the band gap change while adding small amount of aluminum (Al) or indium (In) into GaN? [5 分]
3. (a) Plot the band diagram of an intrinsic semiconductor. Label both the work function ϕ and the electron affinity χ on this plot. [5 分]
(b) There are two semiconductors possessing the *negative electron affinity* and the *positive electron affinity*, separately. Where will their excited electrons move to when the surfaces of the semiconductors are in contact with vacuum? [5 分]
4. Compare both structure and the softening point T_{sp} of silica glass and sodium silicate glass. [10 分]
5. Plot the atomic packing of the (111) plane of a face-centered cubic crystal. Label the Burgers vectors of the perfect dislocations in the Miller indices on this plot. [10 分]
6. When will be a dislocation of Burgers vector b_1 split into two dislocations b_2 and b_3 ? [5 分]
7. Plot the molecular structures of the isotactic, syndiotactic and atactic polypropylene (pp). [10 分]
8. Plot the $\ln \sigma$ (conductivity) vs. $1/T$ for an n-type semiconductor. Give the slopes of the plot at both high temperature region and low temperature regions. [15 分]
9. (a) Plot binary phase diagram possessing the peritectic reaction $Liquid + \alpha \rightarrow \beta$, where the α and β are solid solutions. [8 分]
(b) Schematically represent the progress microstructure development of the peritectic reaction during cooling. [7 分]

