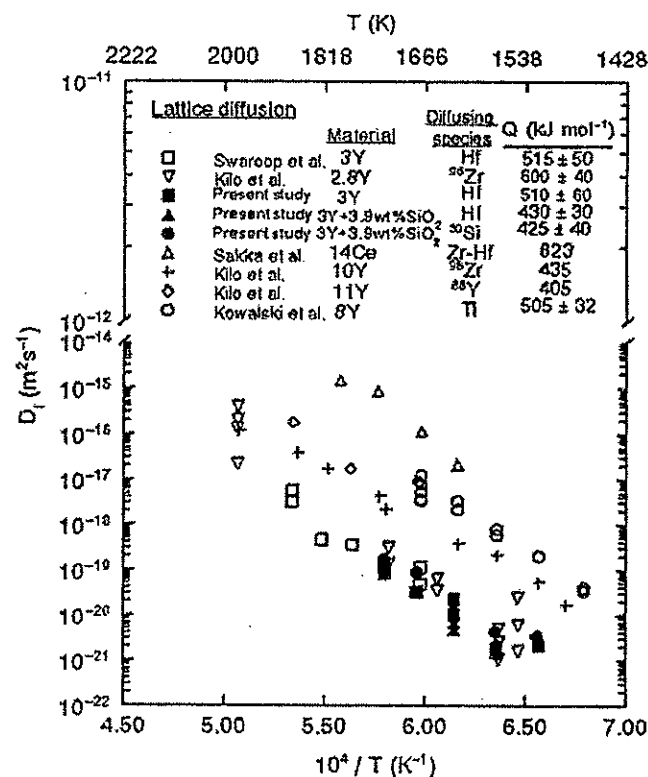


1. (8%) Regarding the 14 Bravais lattices, explain why there is no based-centered tetragonal.
2. (12%) For copper (Cu), the lattice constant of it is 0.36 nm. Please calculate the parameters below.
 - (a) (4%) The angle between planes (111) and (211).
 - (b) (8%) The d spacing of planes (111) and the d spacing of (211)
3. (8%) There are regular dots as shown below in real space. Please draw the reciprocal lattice of them and explain your thought when doing it.

.
4. (12%) For the same metal, say gold (Au), which one has higher strength and the reasons.
 - (i) Au with coarse grains v.s. Au with fine grains. (2%) Why? (4%)
 - (ii) Au with fine grains v.s. Au with twinning. (2%) Why? (4%)
5. Estimate the diffusion coefficient of Zr^{4+} ion through lattice at 1500 °C from the following figure.(10%)

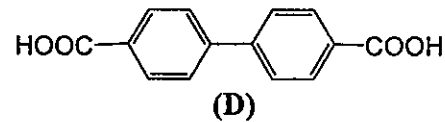
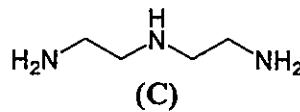
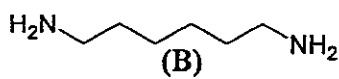
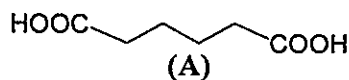


(ref: Ghosh et al. 2009)

6. Name all the possible defects in pure barium titanate, assuming there is only Schottky defects are present. (10%)

見背面

7. Polyethylene (PE, $-(\text{CH}_2\text{CH}_2)_n-$) is a common commercial polymer, which can be obtained by chain polymerization of ethylene ($\text{CH}_2=\text{CH}_2$) as the monomer.
- (3%) Briefly describe how this chain polymerization proceed by providing the major reaction steps.
 - (5%) When a linear PE has a molecular weight (MW) $> 100,000 \text{ g mol}^{-1}$, it can be used for high density PE (HDPE) with good mechanical strengths (Young's modulus $\sim 40 \text{ MPa}$) and opaque appearance. When lowering the MW of linear PE to $3,000 \text{ g mol}^{-1}$, the polymer appears transparent with a much lower Young's modulus $\sim 10 \text{ MPa}$. Explain the molecular weight effect on these observations.
 - (2%) Using viscometer is a simple method to distinguish low MW PE and high MW PE by measuring the relative viscosity of the polymer solution in the same concentration. Which PE would exhibit higher viscosity, why?
8. 4 monomers shown below are in stock for you to prepare designated polymers.
- (4%) Which monomers should you use to synthesize a polymer having "thermoplastic" properties with low T_g (glass transition temperature)? Provide the chemical structure of the polymer you obtain and briefly explain why this polymer could exhibit the desired properties.
 - (2%) Continue from (a), which monomers should you use to synthesize a polymer having similar "thermoplastic" properties but with a higher T_g ?
 - (4%) Which monomers should you use to synthesize a "thermoset"-like polymer? Provide the molecular structure of the polymer you obtain and briefly explain why this polymer could exhibit the desired properties.



9. (10%) Photodetectors for image sensors are the key components in various electronic systems. Please list the materials used for photodetectors to detect the waves in ultraviolet, visible, near-infrared (IR), and mid-IR regions, respectively. Please also describe the possible mechanisms for these detectors.
10. (10%) (a) What is a superconductor? When applying (b) a static electric field, (c) a static magnetic field, and (d) an electromagnetic wave around a superconductor, what are the distributions of the fields inside the superconductor?

試題隨卷繳回