

國立臺灣科技大學

九十二學年度博士班招生考試試題

系所組別：工程技術研究所材料科技學程博士班

科目：材料科學

共 100 分

1. (25%) Plutonium sulfide, PuS, is cubic and the eight lines of lowest Bragg angle on its X-ray powder photograph, taken with $\text{CuK}\alpha$ radiation ($\lambda=1.5418\text{\AA}$), have the following values of θ :

13.95°, 16.17°, 23.19°, 27.50°, 28.84°, 33.84°, 37.37°, 38.51°.

Index these lines, determine the lattice type, and evaluate the unit-cell dimension a .

2. (25%) A diffractometer scan of a nanocrystalline composite consisting of platinum nanocrystals (50 Å in diameter) in a matrix of amorphous carbon is taken using $\text{CuK}\alpha$ radiation ($\lambda=1.5418\text{\AA}$). Calculate full width at half maximum (FWHM) of the broadened diffraction line of {111} reflection ($2\theta = 39.76^\circ$) on the 2θ scale (degrees).

3. (25%) Derive the following equation for an ideal gas:

$$c_p - c_v = R$$

(c_p : the constant-pressure molar heat capacity; c_v : the constant-volume heat capacity;
 R : gas constant)

4. (25%)

(1) Plot the phase diagram of a binary eutectic system A-B. (8%)

(2) Plot the molar Gibbs free energy of mixing curves at the temperature T_1 . (T_1 is between the melting point of A and B.) (8%)

(3) Plot the activity curves of the components of the system A-B at T_1 . (9%)

