

Session #18: Homework Problems

Problem #1

- (a) In a diffractometer experiment a specimen of thorium (Th) is irradiated with tungsten (W) L_{α} radiation. Calculate the angle, θ , of the 4th reflection.
- (b) Suppose that the experiment described in part (a) is repeated but this time the incident beam consists of neutrons instead of x-rays. What must the neutron velocity be in order to produce reflections at the same angles as those produced by x-rays in part (a)?

Problem #2

A Debye-Scherrer powder diffraction experiment using incident copper (Cu) K_{α} radiation gave the following set of reflections expressed as 2θ : 38.40°; 44.50°; 64.85°; 77.90°; 81.85°; 98.40°; 111.20°.

- (a) Determine the crystal structure.
- (b) Calculate the lattice constant, a .
- (c) Assume that the crystal is a pure metal and on the basis of the hard-sphere approximation, calculate the atomic radius.
- (d) Calculate the density of this element, which has an atomic weight of 66.6 g/mol.

Problem #3

The following diffractometer data (expressed as 2θ) were generated from a specimen irradiated with silver (Ag) K_{α} radiation: 14.10°; 19.98°; 24.57°; 28.41°; 31.85°; 34.98°; 37.89°; 40.61°.

- (a) Determine the crystal structure.
- (b) Calculate the lattice constant, a .
- (c) Assume that the crystal is a pure metal and on the basis of the hard-sphere approximation, calculate the atomic radius.
- (d) At what angle θ would we find the first reflection if, instead of K_{α} radiation, we used silver L_{α} radiation to illuminate the specimen?

Problem #4

What is the maximum wavelength (λ) of radiation capable of second order diffraction in platinum (Pt)?

Problem #5

What acceleration potential (V) must be applied to electrons to cause electron diffraction on {220} planes of gold (Au) at $\theta = 5^\circ$?

Problem #6

How can diffraction on {110} planes of palladium (Pd) be used to isolate K_α radiation from the "white" spectrum of x-rays emitted by an x-ray tube with a copper (Cu) target? Rationalize your answer and provide an appropriate schematic drawing.

MIT OpenCourseWare
<http://ocw.mit.edu>

3.091SC Introduction to Solid State Chemistry
Fall 2009

For information about citing these materials or our Terms of Use, visit: <http://ocw.mit.edu/terms>.