

Homework #8

October 27, 2009 (to be tested on Nov. 3)

from Averill, Chapter 12: 22, 23, 25, 26, 81, 82

from Shackelford, Chapter 3: sample problems 20, 21

plus these additional questions:

1. (a) In a diffractometer experiment a specimen of thorium is irradiated with tungsten 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)?
2. A Debye-Scherrer powder diffraction experiment using incident copper 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.
3. The following diffractometer data (expressed as 2θ) were generated from a specimen irradiated with silver 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?
4. What is the maximum wavelength (λ) of radiation capable of second order diffraction in platinum (Pt)?
5. What acceleration potential (V) must be applied to electrons to cause “electron diffraction” on {220} planes of gold (Au) at $\theta = 5^{\circ}$?
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 and appropriate schematic drawing.)?