July 30, 2000

Experiment X3

Be sure to read the notes "Exposure to Ionizing Radiation" before starting. Nick will check you out on the use of the x-ray equipment prior to use. You are responsible for monitoring the radiation to make sure you have proper shielding and for filling out the log each time you use the x-rays. If you have no previous experience with x-rays, you might also read the notes for experiment X-1 for introductory references on x-ray production, absorption and safe dose. Cullity and Warren(see references) also discuss some of the basic material.

Transmission and Back-reflection Laue Photographs

1. Take a Laue transmission photograph of one of the alkali halide single crystals provided using 34 KV molybdenum radiation, 10 ma and 4 cm crystal to film distance. With such a crystal, a principal crystallographic axis is normal to a cleavage plane. Your photograph should be taken with the beam aligned as close as possible to this axis (see remarks on alignment below). You will probably need to take at least two photographs to get the alignment reasonably precise.

   Plot the gnomonic projection of each photograph, using the D= 4 cm projection ruler provided *. Index the spots (Miller indices), and use the short wave length limit, the intensity information and the missing spots to estimate the upper and lower bounds on the lattice constant, assuming the crystal is cubic. Show that the symmetry of the picture agrees with the assumption the crystal is in fact a cubic one †. From the missing spots, is the crystal fcc or bcc? What are the possible alkali halides?

2. Take a back-reflection Laue photograph of a silicon single crystal with a film to crystal distance of 3 cm. Use the Greninger chart provided and plot a stereographic projection of the principal reflections. From this projection, find the orientation of the vertical (i.e. the line of the x-ray beam through the specimen) and the unit triangle formed by the zones [001],[011],[111]. Identify the other principal zones, and assign Miller indices to the principal spots. This can be done by using the table of angles between crystallographic planes or by rotating the stereographic projection into the standard [100] chart provided (see also Cullity). Finally, give the orientation of the crystal relative to its holder (assumed to be parallel with the film). State your precision.

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* See the notes for how to use the ruler

† Is there any other possibility? See reference 6