Introduction to Crystallography (Homework No. 3)

Due Date: October 8, 2008

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1. The stereographic projection provides means for representing three-dimensional spatial information on a two-dimensional drawing. The origin of all directions is chosen to be the center of the sphere. The directions are radial and intersect the surface of the sphere, and are then projected to the equatorial plane.
   (a) Choose the center of a cube as the origin and orient one face parallel to the equatorial plane. Identify the six directions parallel to the cube faces (i.e., the positive and negative x, y and z axis directions) and plot them on a stereogram (make its diameter equal to the Wulff net). Assign each pole its proper Miller index. Conventionally 001 is in the center, 100 at the bottom, and 010 to the right (the last two on the primitive), consistent with right-handed axes.
   (b) Identify the eight cube diagonal directions (the <111> directions) and plot them accurately on the same stereogram. To locate these poles first calculate the angle between the cube diagonal and two cube axes. Use the intersection of the corresponding small circles to establish the pole positions and give each of them their Miller index.
   (c) Higher index poles are readily found by computing their angular distance from two low index poles (usually two on the primitive), and then by finding the intersection of the corresponding small circles (the same procedure used to find the <111> poles above). Find [211], [131] and [513] using this technique. (As we have seen through the first problem session, the <211> direction is the twinning direction in FCC.)

2. We want to construct a stereographic projection for a hypothetical orthorhombic crystal ($a \neq b \neq c$, $\alpha=\beta=\gamma=90°$) with the following parameters:

   $$a = 7.48 \text{ Å} \quad b = 4.9 \text{ Å} \quad c = 2.5 \text{ Å}$$

   (a) Draw the {100}, {010}, {001}, {110}, {101}, {011}, and {111} planes as poles.
   (b) Draw the <100>, <010>, <001>, <110>, <101>, and <011> zones as great circles.