Homework 1; different representations of orientations (as rotations).

Due: Sept. 6th, 2011

1. Assume that we dealing with a cubic material. What are the direction cosines associated with (a) the direction [110]? (b) The direction [321]?

2. The objective of this question is to see for yourself how an axis transformation works, and what the difference between this and a vector rotation is.
(a) Draw a x-y set of Cartesian axes and add to the diagram a second set of perpendicular axes, x' and y' that represent a 2D axis transformation (rotation in a plane) through a positive (anti-clockwise) angle \( \theta = 30^\circ \). Write down the matrix that describes the rotation in terms of sine and cosine functions (if this is not obvious, use the formula given in the slide for constructing the matrix based on scalar products between basis vectors).
(b) Calculate the coefficients of a unit vector parallel to [31] in the first set of axes ([31] is the same thing as [310] in 3D but simply omit the third coefficient.)
(c) Calculate the coefficients of the same unit vector in the second, new set of axes.
(d) Now make another diagram that shows a vector rotation through the same angle. Write down the matrix and explain in your own words why the two matrices are similar but different.
(e) Take the same unit vector // [31] and apply the active/vector rotation to it (i.e. calculate the coefficients of the new vector). Compare your result to the one in part (c) above.

3. Based on your reading of the review paper by Wenk and van Houtte, answer the following questions.

a) What is the difference between “texture” as we have defined it and “shape texture”?
b) What is the difference between the Roe (=Matthies) definition of Euler angles and the Bunge definition?
c) What is meant by a “fiber texture”?  
d) The discussion of ceramic texture makes reference to particle shape. Explain with the aid of a diagram how anisotropic particle shape can lead to texture (and shape texture) development during some of the processes used in powder processing of ceramics.
e) Explain what meant by the adjective “epitaxial” in connection with thin film texture.
f) Explain what is meant by “seismic anisotropy”.