27-750 Advanced Characterization and Microstructural Analysis, Spring 2016

A.D. Rollett: last revised on Jan. 14th, 2016.

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

Due: Jan. 19th

[100 points]

Q1. [10] Assume that we dealing with a cubic material. What are the direction cosines associated with (a) the direction [110]? (b) The direction [321]?

Q2 [30] The position of sample reference frame is shown in the below circle (ND is out of the plane). For each set of Euler angles (phi1, phi, phi2), show the positions of [100], [010] and [001] in the three successive rotations as each Euler angle is applied.

1. ( 45, 45, 0)
2. ( 0, 30, 60)
3. ( 30, 45, 60)

TD//e2

ND//e3

RD//e1

Q3. [20] Read the 1965 paper by Dillamore & Roberts (look on Blackboard under “Course Content” and “Useful Files”) and answer these questions.

a. [5] What effect does varying the strain rate and temperature have on texture development, to first order?

b. [5] Which two fiber texture components develop when uniaxial tension (wire drawing) is applied to fcc metals?

c. [10] Figure 11 shows {10-10} pole figures for various rolled hexagonal metals, which are fairly similar to one another. Based on these and the descriptions in the text, sketch a (0001) pole figure that is consistent with these textures. Be sure to explain how you arrived at your answer. Hint: remember that (0001) and {10-10} are mutually perpendicular.

Q4. [15] Read the 2004 paper by Wenk & van Houtte (look on Blackboard under “Course Content” and “Useful Files”) and answer these questions.

a. [5] What effect does a platy particle shape (flat discs) have on texture development, e.g. when powder compacts are compressed? Give an example from the paper.

b. [5] Which texture component in a TiN coating is more resistant to erosion?

c. [5] Which crystal direction (or plane normal) in aragonite in nacre is normal to the surface of mollusc shells?

Q5. [25] Use the R package to analyze the data set in ReducedDiameter\_StagDerrJih\_Cu\_A-O.csv. Make the following plots:

a. A frequency histogram of the data

b. A probability density plot of the data

c. A probability plot of the data; note that the package e1071 can be used to do this.

d. A frequency histogram of the log(data)

e. A probability density plot of the log(data)

f. A probability plot of the log(data).

g. Comment on whether you think the data follows a normal or a log-normal distribution. You should be able to easily find information about probability plots.