

27-750 Advanced Characterization and Microstructural Analysis, Spring 2016

A.D. Rollett: last revised on Jan. 14<sup>th</sup>, 2016.

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

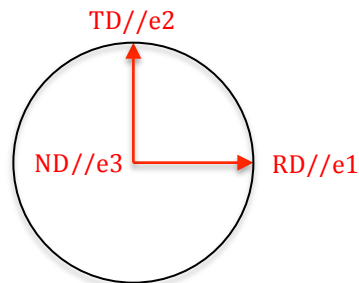
Due: Jan. 19<sup>th</sup>

[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 ( $\phi_1$ ,  $\phi$ ,  $\phi_2$ ), show the positions of [100], [010] and [001] in the three successive rotations as each Euler angle is applied.

- a) ( 45, 45, 0)
- b) ( 0, 30, 60)
- c) ( 30, 45, 60)



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  $\{10\cdot10\}$  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  $\log(\text{data})$
- e. A probability density plot of the  $\log(\text{data})$
- f. A probability plot of the  $\log(\text{data})$ .
- 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.