

27-750, Spring 2016
Homework 4

Due – 11:59pm Feb. 10th

1. [50] For this homework, I want you to keep a journal or notebook of your work to learn how to use MTEX (inside Matlab). Be thorough in documenting the work. If all you do is to paste a series of pictures into the document you will lose points. To ensure that you receive full credit, give explanations of each step and what your interpretation is of each result. It does not have to be exactly correct in this exercise – I mainly am interested in seeing you learn how to use the mtext analysis tool. Later on we will review the textures that are typically found in metals and calculate the anisotropy of their properties. In fact some basic tools are found in MTEX, such as elastic anisotropy.

1A. [40] Input and analyze the EBSD dataset called fw-ar-IF1-avtr12-corr.ctf, which was acquired on a sample of a so-called interstitial-free (IF) steel. Make a plot of the microstructure with and without grain boundaries. Plot pole figures, inverse pole figures, ODF sections and 3D view of ODF. Comment on the texture and compare to what you can find in the notes or in the literature on rolled bcc metals since this is a rolled interstitial-free steel. In particular comment on the strengths of the alpha and gamma fibers in this texture. Hint: you can find most of this analysis in the MTEX lecture notes.

1B. [10] Referring back to the application example shown of the effect of texture on the earing of sheets formed into cups, do you expect the r-value of this steel to be high or low? What about the variation in the r-value with direction in the sheet (Δr)?

2. [30] In addition to the MTEX exercises, answer the following questions. Two or three sentences should be sufficient.

2A. [10] Explain in your own words why a defocussing correction must be applied to an experimentally measured x-ray pole figure.

2B. [5] Explain in your own words why the data (i.e. the intensity values) in an experimental pole figure must be normalized.

2C. [5] Write down the formula for the entropy associated with a texture (i.e. the orientation distribution).

2D. [5] The value of the OD is allowed to be exactly zero. How is this problem dealt with when computing the entropy? Hint: the answer can be found either online or in one of the sets of lecture notes that deals with pole figures.

2E. [5] Explain why the entropy associated with a texture is zero for a perfectly random texture and increases with the texture strength. Comment on whether this makes physical sense to you i.e. that the most random condition corresponds to zero entropy.

3. [20] Volume fraction calculation

3A. [10] For cell-edge binning with a 5° increment (cell width), if all the orientations of a material fall into a single cell with $\Phi=0^\circ$, what (to 2 significant figures) is the intensity (in MRD) associated with that cell?

3B. [10] For cell-edge binning with a 5° increment (cell width), if all the orientations of a material fall into a single cell with $\Phi=55^\circ$, what (to 2 significant figures) is the intensity (in MRD) associated with that cell?