MSE 460 TEM Lab 3:

Selected Area Electron Diffraction and Kikuchi Lines

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Aims: The aim of this lab is to familiarize you with selected area electron diffraction (SAED) patterns and Kikuchi lines. SAED patterns and Kikuchi lines should be recorded when the electron beam is nearly parallel to a zone axis of the sample. These patterns and some Kikuchi lines should be properly indexed as part of the lab report. *(Note: if it does not work this week, you can get some more pictures next week.)*

TEM: JEOL-2100F TEM

Time: 3 hours

You may need your notes from earlier labs. Please bring them with you.

Here are some tips for you:

TIP A: Read a couple of chapters about electron diffraction and Kikuchi lines in a TEM book, e.g. the textbook for the course. Understand how they are generated and know what characteristics they have. It will be helpful if you understand some important concepts such as elastic scattering, inelastic scattering, Bragg condition, Ewald sphere, and reciprocal lattice. *These will be covered in the class, but there is always a period when the lectures run behind the labs.*

TIP B: You may want to spend the first hour to repeat what you leant in last lab. It includes:

I. Getting familiar with the TEM structure, functions and knobs
II. TEM startup
III. Obtaining a good electron illumination
IV. Setting the sample at the eucentric height
V. Condenser lens alignment
VI. Beam tilt purity
VII. Objective lens alignment (Voltage center)
VIII. Image focus and astigmatism correction (Fresnel-fringe method)

You should plan on spending the rest of the time tilting the specimen, recording SAED patterns and Kikuchi lines, shutting down the TEM. *DO NOT SPEND TOO LONG ON THE INITIAL SETUP.*

IX. Specimen tilt

TIP C: You need to use a double tilt specimen holder to tilt the specimen to a zone axis orientation.
TIP D: Make sure that the specimen is at the eucentric height before tilting it – this makes it much easier as well as safer (clear of the objective aperture).
TIP E: To monitor the specimen tilt, you want to keep an eye on the diffraction pattern formed from a reasonable thick area using a convergent beam while you tilt. It can be easier to use an unfocussed diffraction pattern. This requires some hand-eye co-ordination, and you have to work out for yourself what works best for you. Until you are familiar with the process, it is probably better to only use one tilt at a time (not both simultaneously).
TIP F: Figure out the relationship between the diffraction pattern changes and the direction(s) which you are tilting.
TIP G: Keep the interesting area (at least one you hope is interesting) centered using the translates. You may want to stop the tilting, go back to imaging and look at the region that you have from time to time.

X. SAED patterns and Kikuchi lines

TIP H: Make sure that the image of the interesting area is present on the screen in selected area mode.
TIP I: Make sure that the diffraction pattern is properly focused – but not with convergent illumination, rather defocused (i.e. close to parallel) illumination. Use the **DIFF FOCUS knob** to focus the pattern while the **SA/DIFF** switch is on.

TIP J: If you cannot see Kikuchi lines on the screen, try a thicker area.

XI. TEM shutdown (see lab 2 note)

NOTE**: The **MAG/CAM L** knob varies the normal magnification when the **MAG1** or **MAG2** switch is pressed, and the low magnification when the **LOW MAG** switch is pressed; and varies the selected area magnification when **SA MAG** is selected and the camera length when **SA DIFF** is selected. **Turning this knob clockwise increases the magnification or camera length and turning it counterclockwise decreases the magnification or camera length.