MSE 460 TEM Lab 5:
Convergent Beam Electron Diffraction (CBED)

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Aims: The aim of this lab is to familiarize you with Convergent Beam Electron Diffraction (CBED) and record CBED patterns of Si in the [111] direction.

TEM: JEOL-2100F TEM

Sample: Silicon (111)

Time: 3 hours

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

You may spend the first hour to repeat what you leant in Lab 2. It includes:

I. Get familiar with TEM structure, functions and knobs
II. TEM startup
III. Obtain a good electron illumination
IV. Set the sample at 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)

IX. Convergent beam electron diffraction

A CBED pattern is obtained using a convergent electron beam instead of a parallel beam. It contains three-dimensional information of a specimen and can used to determine specimen thickness, symmetry, and unit-cell of your specimens.

1. Find and center an interesting specimen area
2. Make sure that the sample is at eucentric height and **BRIGHT** field mode is selected.
3. Focus (**BRIGHTNESS**) the beam to the crossover and press **DIFF.**
4. Take out **OBJ APERTURE**.
5. **C**enter the transmitted beam of the diffraction pattern if necessary
6. Tilt the specimen to the Si [111] zone axis.

7. Focus the diffraction pattern

Tip: It is not always easy to focus a pattern in CBED mode. You may obtain a selected area diffraction (SAD) pattern and focus it. After the diffraction pattern is focused in SAD mode, the CBED pattern will be focused. Note: if you have a thicker sample you may be able to use the HOLZ lines in the central disc for the focus.

8. Choose exposure time

Tip: It is necessary to select a few different exposure times to record the same pattern so that both ZOLZ and HOLZ can be seen clearly. If you want to see fine details near the ZOLZ center, very short exposure times may be necessary.

9. Use RIO camera to record CBED patterns.
10. Move around the specimen to see the effect of thicknesses on the convergent beam pattern. You may want to take more pictures if you find better conditions.

X. Shut down the TEM (see Lab 2 notes)

Note if you have extra lab time:

If you feel that you didn't have enough pictures of crystal defects from Lab 4, some of you may want to take advantage of the easy tilt offered by the single crystal specimen and use your skills at BF/DF to examine defect structure in the silicon specimen. Things to look for: dislocations, stacking faults, and strain fields due to these defects.