TEM Specimen Tilting Holder

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Besides the standard specimen holder, a specimen tiling holder is also available for JEOL JEM-2010 and FEI Tecnai Osiris electron microscopes in NCMN CFEM. The tilting holder on the goniometer allows a TEM specimen to be tilted in two directions simultaneously. The specimen tilting holder is a key component for advanced transmission electron microscopy. In this application note, we introduce the usage of the TEM specimen tilting holder.

Figure 1. (a) Specimen tilting holder on FEI Tecnai Osiris S/TEM. (b) Schematic diagram of a specimen tilting holder. $\alpha$ is the tilt angle around the holder axis and $\beta$ is the tilt angle around the orthogonal axis to the holder.

If the specimen is tilted from one position defined by the angles $\Phi_i$ and $\xi_i$, to another position $\Phi_j$ and $\xi_j$, the angle $\epsilon_{ij}$ between these two positions of the specimen is given by the following formula [1]:

$$\cos \epsilon_{ij}(\xi, \Phi) = \cos \left( \xi_j - \xi_i \right) \cos \Phi_i \cos \Phi_j + \sin \Phi_i \sin \Phi_j$$

In the experiment, (i) make sure that the specimen is at the eucentric height before tilting it; (ii) figure out the relationship between the diffraction pattern changes and the tilting directions; (iii) keep the interesting area centered using
the shift x and y in imaging mode; (iv) record the diffraction pattern and tilting angles.

![Stereographic projection showing the relative position of the electron beam and the specimen axes after a double tilt](image)

Figure 2. Stereographic projection showing the relative position of the electron beam and the specimen axes after a double tilt [2].

An example of electron diffraction patterns obtained on the intermetallic compound μ-HfCo [3] is shown in Fig. 3.

![Selected area electron diffraction patterns of μ-HfCo phase](image)

Figure 3. Selected area electron diffraction patterns of μ-HfCo phase, (a) exactly at [100] zone-axis and (b) tilted away about 1.2° with extinction spots.

