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Memo, Auto Tune using at the EM Lab TEM

This memo is a summary for testing the routine TEM Auto Tuning from the Gatan DM (Digital-Micrograph, Gatan) by using a "fish-bone" nano-fibre specimen on the amorphous TEM grid for the future easy-using reference.

The testing was following the 4 different tuning sections as shown on the right figure from the DM menu. Before and after tuning results are given here, together with the practical using notes. The corresponding turning status-result files were saved into the web folder FYI, at http://folk.ntnu.no/yingday/NilsYD/TEMCCDbasic
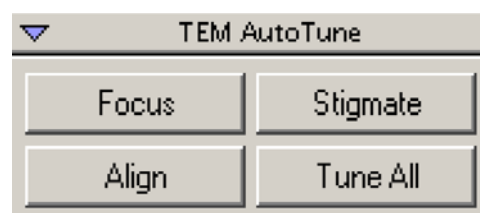
A good autotuning start-point is that the TEM should be roughly at the correct pre-alignment condition. The auto tuning is not effective when the TEM is severely mis-aligned.

For practical pre-alignment, please try to follow the alignment procedures as outlined in the JEM-2010 Handbook-Basic Operation, especially for the alignments of the high voltage centre and objective lens aberration. In addition, the following conditions (/suggestions) should take into your considerations before performing autotuning.

1. For high magnifications, the spot size 3 is better to be used to give a better beam coherency.
2. The beam illumination has to be large enough so that you don't get shadows in the image due to the beam tilt (Gantan manual suggests to use beam tilt angle larger than 4.0 mrad).
3. Choose a suitable CCD binning factor, i.e. balancing the CCD dynamical rang and exposure time. Gantan manual suggests as
Magnifications (150kx – 250kx), binning 1
Magnifications (250kx – 500kx), binning 2
Magnifications (500kx – 800kx), binning 4

The present autotuning tests were carried out both at 150 k and 500 k (for HRTEM turning test) TEM magnifications, which were divided to test for the Auto focus, Auto stigmate, Auto alignment and Auto Tune All.

Following the starting up procedure to open DM software, if the correct communication between the DM and TEM is setup, the following message will be displayed on the DM floating result window, as

_____

Microscope Control Initialization Succeeded.
Dynamic camera registeret.
Welcome to DigitalMicrograph.
_____

Focus Autotuning test

Turn on the focus autotuning either from the DM menu or the DM floating window (i.e.
TEM Auto Tune), then the following message will be displayed on the DM result window, as
_____
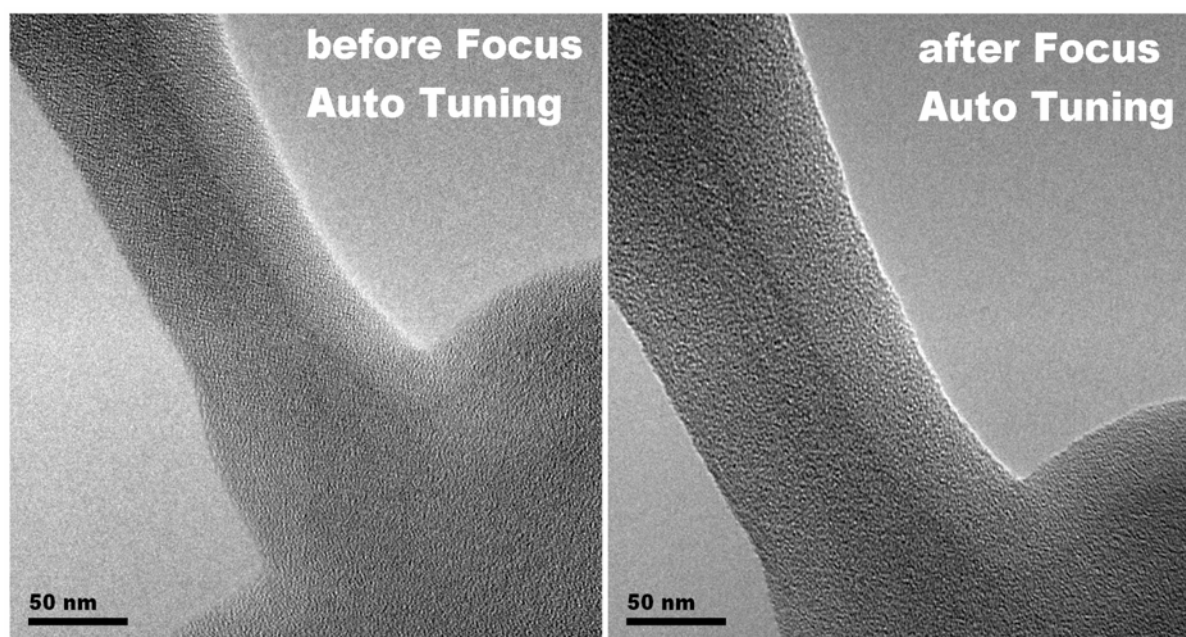Automatic focussing started at:.   2006 00:00:57
…
followed with the detailed tuning parameters
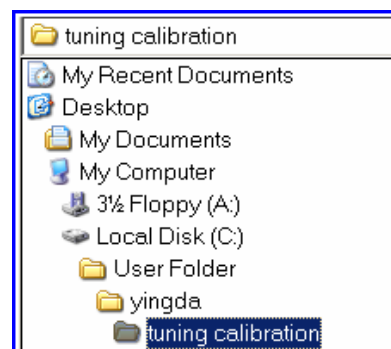…
Automatic focussing finished at: 2006 00:01:59
_____

Here the focus autotuning used 1:02 minute, and as you see the feedback message of the
"Automatic focussing finished at…", this autotuning is OK and ready for using. The resulted
TEM micrographs are shown below,

NB, increasing the fibre size after tuning in all below
micrographs is due to the beam contaminations.

The original TIF images are saved at
http://folk.ntnu.no/yingday/NilsYD/TEMCCDbasic/AutoTuningOriginalPics
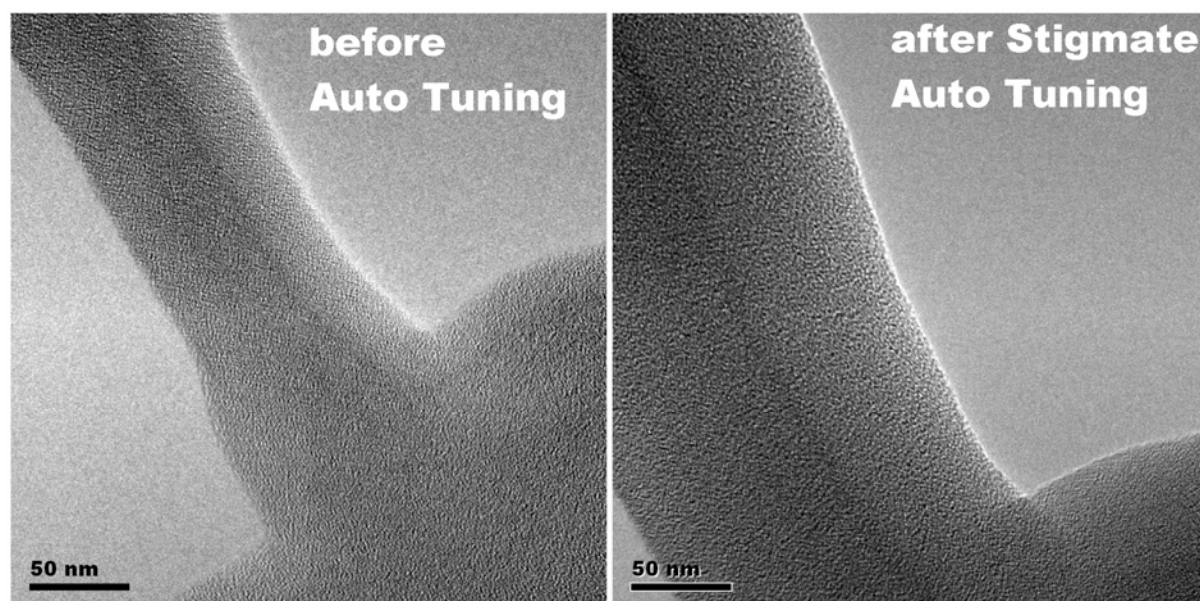
The original DM file Folder path in the TEM DM PC is
shown in the right figure.

The detailed tuning parameters were saved at,
http://folk.ntnu.no/yingday/NilsYD/TEMCCDbasic/AutoTuningStatusFiles/FocusResults.txt
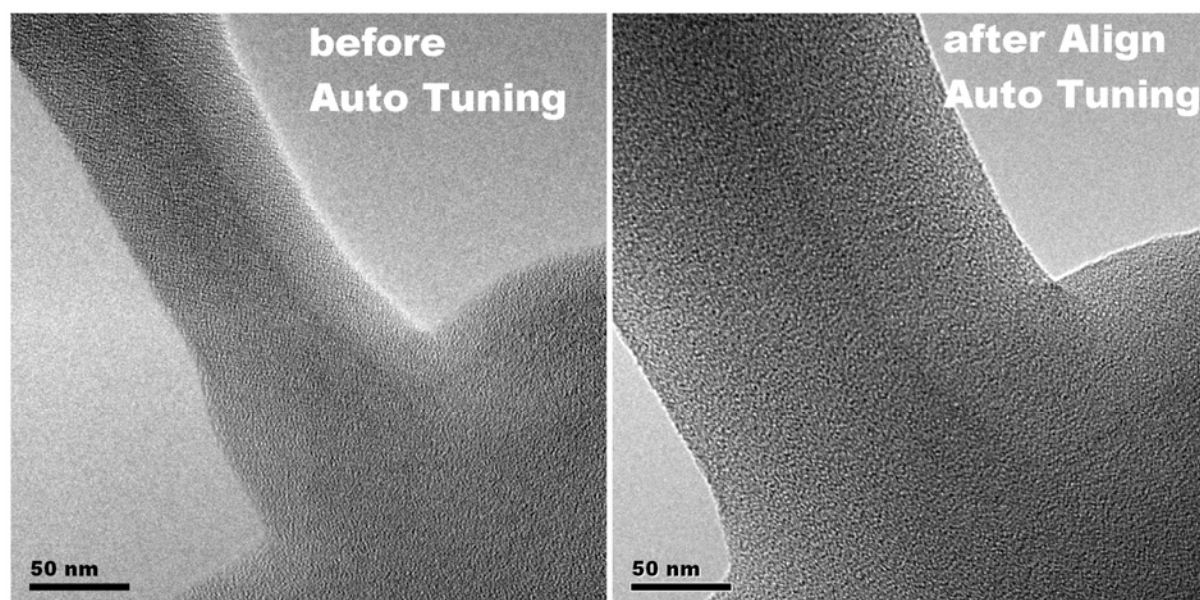
Stigmate Autotuning test

The resulted TEM micrographs with the stigamte tuning are shown below,

The detailed tuning parameters were saved at,
http://folk.ntnu.no/yingday/NilsYD/TEMCCDbasic/AutoTuningStatusFiles/StigmateResults.txt
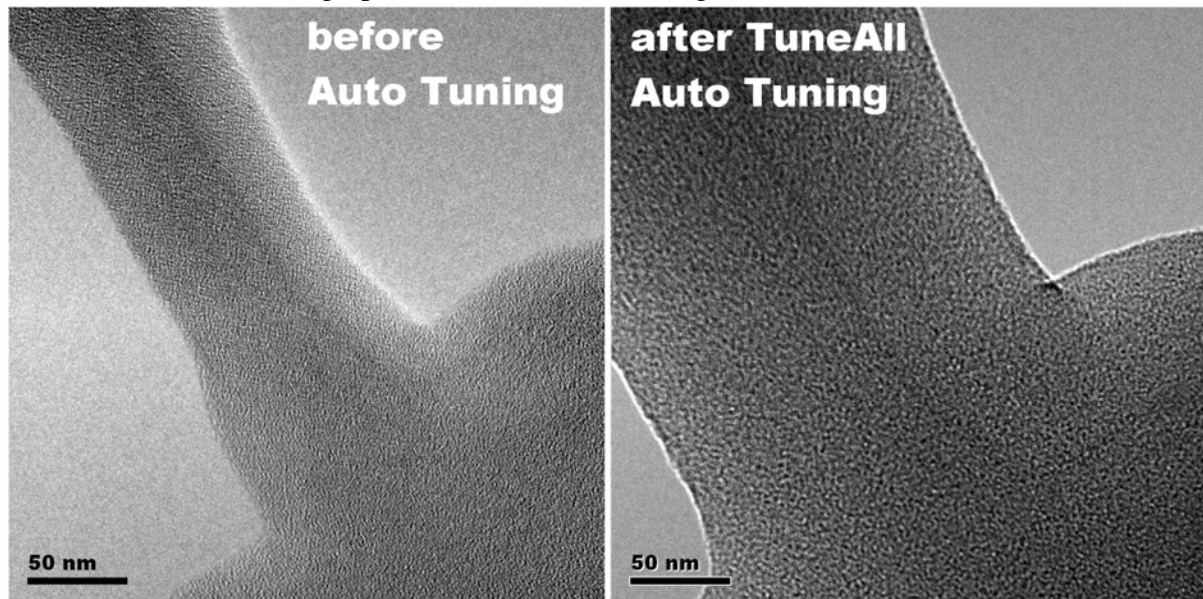
Align Autotuning test

The resulted TEM micrographs with the align tuning are shown below,

The detailed tuning parameters were saved at,
http://folk.ntnu.no/yingday/NilsYD/TEMCCDbasic/AutoTuningStatusFiles/AlignResults.txt
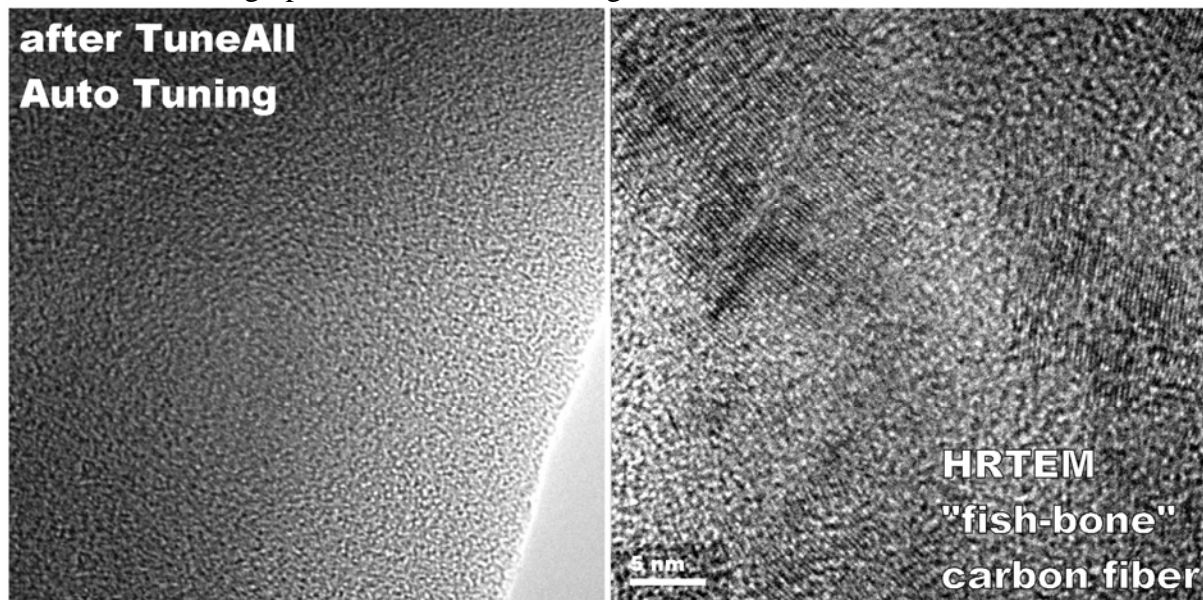
Tune All Autotuning test

The resulted TEM micrographs with the tune all tuning are shown below,

[The detailed tuning parameters](#) was saved at,
http://folk.ntnu.no/yingday/NilsYD/TEMCCDbasic/AutoTuningStatusFiles/TuneAllResults.txt

HRTEM Autotuning test (at TEM 500kx)

The resulted micrograph with the tune all tuning is shown below, with "fish-bone" HRTEM

[The detailed tuning parameters](#) was saved at,
http://folk.ntnu.no/yingday/NilsYD/TEMCCDbasic/AutoTuningStatusFiles/HRTEM TuneAllResults.txt

NB, for HRTEM autotuning, the focus tuning may not give a suitable Scherzer defocus, and a further slight focus alignment is necessary to get so-called HRTEM structure image (i.e lattice image). As you know well, the Scherzer defocus compensates the residual objective lens aberration to give a max "flat" channel (i.e. nearly constant -1 in the reciprocal χ space) on the information transfer function, so that the specimen information could be linearly and undisturbedly transferred into image to get that HRTEM lattice image!