
CCD Image Acquisition Tutorial

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1. Introduction

This document will guide users of Gatan CCD camera through the process of viewing, acquiring and saving images.

2. Hardware

The procedures in this document are applicable to all Gatan CCD camera (DualVision, MultiScan, UltraScan and GIF MSC).

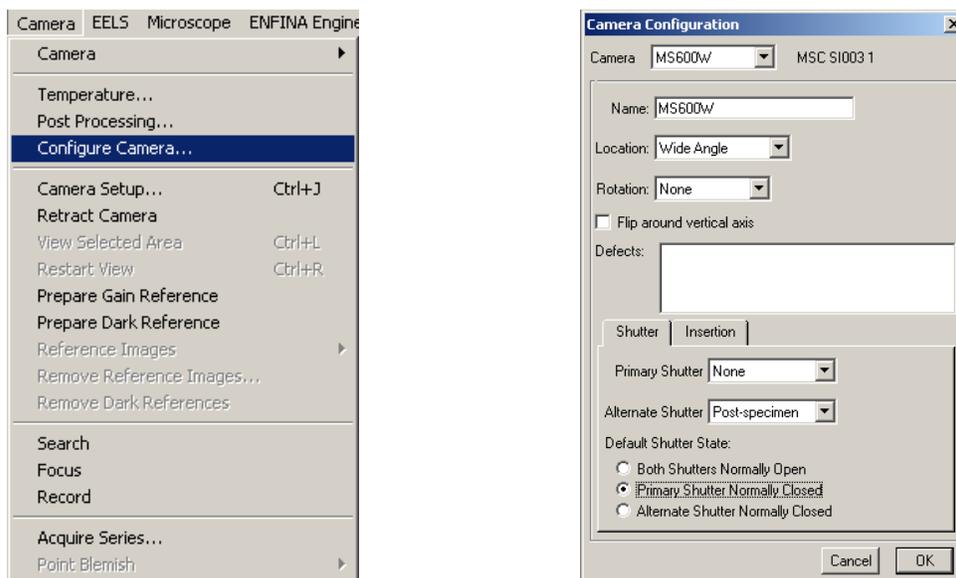
3. Image Acquisition

3.1. Camera configuration

First, it is necessary to select the CCD camera that you will use to acquire images. Select Camera and a list of available cameras will be displayed, as shown below. Select the camera that you wish to configure from the list. The example below shows the Multiscan 600W camera selected.



The next step is to configure the CCD camera. This process is shown in the following figures.



In the Camera configuration dialog box, you can change the name of the camera by typing in the **Name** field. Image rotation can be specified in the Rotation pull-down menu. The coordinates for column defect correction are entered in the **Defects** field. It is very important to specify the **Primary** and **Alternate** (if there is one set up) shutter available to the camera. Finally you should specify the shutter status, i.e. the state of the shutter when the CCD camera is not acquiring any images. “Shutter Normally Closed” is the default setting.

3.2. Prepare dark reference image

This section only applies to DualVision 600 CCD camera which do not have a TEM shutter control. The DualVision 600 camera is shutterless. Since CCD dark current depends upon the temperature, CCD must reach its set target temperature before acquiring the dark reference image.

Before starting the preparation procedure, lower the TEM viewing screen (make sure no electron beam illuminates the CCD sensor during the procedure). Under the **Camera** menu, choose **Prepare Dark Reference** and follow the screen instructions.

3.3. Prepare gain reference image

It is important to prepare a new gain reference image after the CCD has reached the equilibrium temperature (normally this takes about 1-2 hours). The gain reference image should be checked daily.

To prepare gain reference image, remove specimen from the field of view, evenly spread the illumination across the CCD sensor; for wide angle CCD cameras, this could mean that the illumination is evenly spread across the entire viewing screen in the TEM.

Under the **Camera** menu, choose **Prepare Gain Reference**. Set the target intensity to the value of about half the dynamic range. For example, for 14-bit cameras, set the value

to 8000 and 12-bit camera to 2500. Normally it is sufficient to set the frames to average to 4. Then simply follow the instructions on the screen.

3.4. View

The view mode allows user to observe **Live** (continuous) images on the monitor. Its control palette is shown below. The setup has two operation modes which are preset for



easy use. The **Search** mode displays a continuous (low resolution) image with the entire CCD field of view. This is to allow the user to quickly conduct a sample search using the CCD camera. The **Focus** mode displays a continuous image at higher resolution than the **Search** image. Fine adjustment of focus setting can be done with this operation mode.

To increase the image update speed on the monitor, click on the **Focus Loupe**. This allows user to focus image by using a small image area with high speed. The **Auto Survey** updates the image display in real time.

Auto Exposure is enabled and disabled by clicking on the **Auto Exposure** selection box. Similarly the CCD camera is **Inserted or Retracted** with a simple mouse click.

3.5. Record

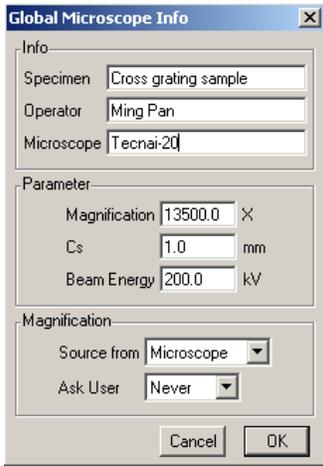
To record the final image, click on the **Start Acquire** button in the Acquire palette (shown below). This mode is preset to acquire a full resolution CCD image. **Auto Exposure** optimizes the CCD exposure to ensure the final image quality.



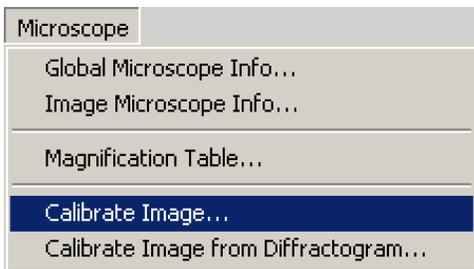
4. Magnification calibration

Since the CCD camera is at different plane in the electron beam path from the TEM photographic film, the magnification displayed on the TEM console does not represent the actual magnification on the CCD sensor. Hence calibration is necessary.

It is very important to make sure DigitalMicrograph software correctly reads the TEM magnification. If there is communication between the computer and the TEM, the magnification is read automatically. If there is no communication, please make sure DigitalMicrograph is set to prompt the user to enter a value for magnification every time an image is to be acquired. This can be set by choosing **Global Microscope Info...** under the **Microscope** menu.



For low magnifications, the user can utilize a standard calibration sample such as a “cross grating” sample which contains periodic lines with a spacing of 0.463 μm . Record a full frame CCD image by clicking the **Start Acquire** button. Under the **Microscope** menu, choose **Calibrate Image....** Follow the instructions on screen. Choose **Yes** when prompted by “Calibrate parent device based on this image?”.



For high magnification, magnification calibration is best carried out by using high resolution lattice images such as graphitized carbon ($d = 0.34\text{nm}$) or gold crystals ($d(111) = 0.23\text{nm}$).

Once an image with crystalline lattice fringes is acquired, choose **Calibrate Image from Diffractogram**. Then follow the instructions on screen.

5. Save

The recorded images are displayed on the monitor. The button with a floppy disk icon is used for saving images. Images can be easily saved in any user specified directory with a common root name. The **Saving** palette is shown below.



5.1 Choosing directory

Click on the **Set up** button (the one with tools). The **Set up** dialog box will be displayed.

In the **Save in directory**, click on the **Browse** button (the one with dots). Select or create a directory for saving images.

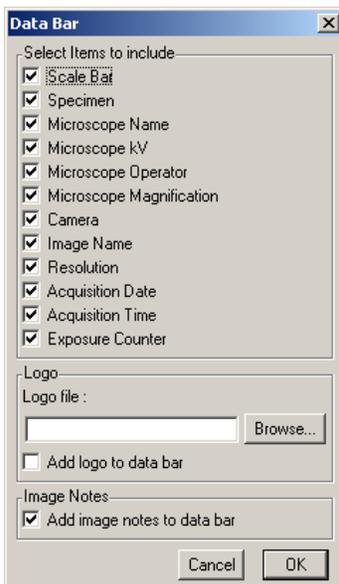


5.2 Construct image file name

In the **File Name Options**, specify the way you want the image file name to be constructed.

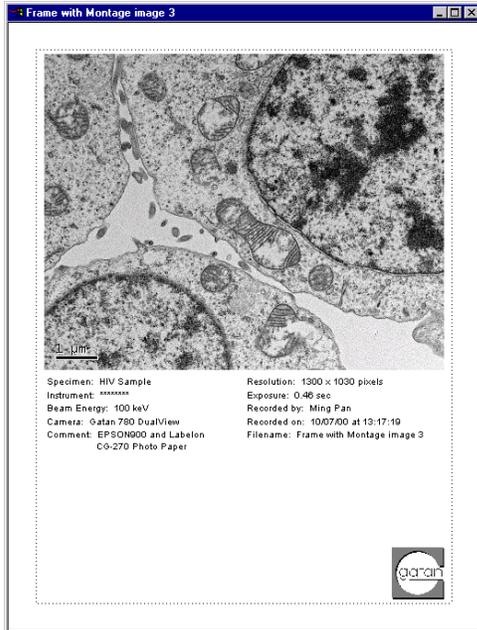
5.3 Report Options

Click on the **Report Options** button to view the following dialog box. You can choose to have any parameters listed to be included in your report. You can also add a logo file and image notes to the report.

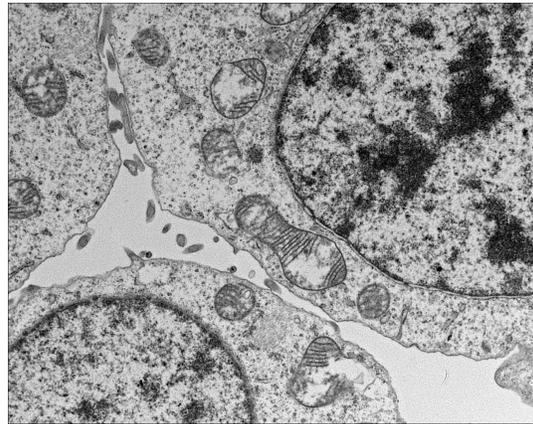


5.4 Report

The report button (the one with a page and a magnifier on the Save palette) will toggle between image view and report view. In the report view, an image is displayed of the print preview mode with parameters as specified in the **Report Options**. Click on the printer icon and the report will print out on your selected printer.



(Report view)

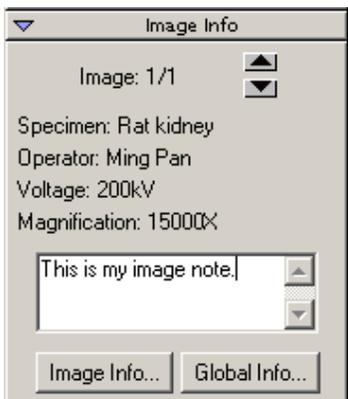


(Image view)

Users can customize the layout and selection of parameters on the page and save the setting as a report template. This is done by clicking the **Save As Default Layout** button in the **Save setup** dialog.

5.5 Image Notes

The user can type in notes in the **Image Note** window (shown below). Saving an image will automatically save the image notes with the image file. The **Up/down arrows** allow user to browse through the images saved in a session.



5.6 TEM Session Information (Global Info)

Before acquiring any images, it is recommended to enter the correct information about the sample, operator, TEM name, etc. Click on the **Global Info** button (shown above). The global information is saved automatically with every image that is acquired.

6 Quick Reference

The steps necessary for operating Gatan CCD camera are summarized here.

1. Check the TEM session information by clicking on the **Global Info** button on **Image Save** palette.
2. Prepare dark reference image. (For DualVision 600 CCD camera only)
3. Prepare gain reference image.
4. Click on “**Start View**” on the **View** palette to position sample area of interest. Enable **Auto Exposure**.
5. Click on **Focus Loupe** to check the final focus. Make sure **Auto Survey** is checked.
6. Click on **Start Acquire** button in the **Image Acquire** palette. Enable **Auto Exposure**.
7. Calibrate magnification (optional).
8. Click on **Report View** button to view image in print preview mode.
9. Click on **Save** button to save image in the designated folder.
10. Click on **Print** button to send image to printer.