

UV light microscope: Improvements in optical imaging for Secondary Ion Mass Spectrometer

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Electronic Supplemental Information (ESI) -1 on Badgerscope© Software Overview

Main Window

High definition sample image and Menu are shown in the main window (Fig. S1a-b). The default image is grey scale with brightness and contrast set by the Auto Exposure function and the image displayed at lowest magnification (Fig. S1a). The Menu area consists of the Image Toolbar, Operate/Setting Tabs (Fig. S1c-d), and the Stage Control.

Image Toolbar

This toolbar (upper left hand corner of the image) allows the user to select various tools for interacting with images.

- When the Arrow cursor is selected clicking within the image causes the stage to move, centering the clicked point at the center of the field of view.
- When the magnifying glass or the panning tool (hand) is selected the image can be zoomed (Fig. S1b) and panned as desired.
- The rectangle and rotated rectangle tools allow the user to interactively define a subspace on the image. Whenever one of these rectangular areas is added to the image, the software calculates and displays a vertically integrated linescan of the selected part of the image. This linescan can be used for judging focus quality.

Stage Control

The Badgerscope© communicates with the CAMECA CIPS software over the serial interface to allow stage movement commands to be executed by the native control system. The position of the sample stage can be moved in the X and Y directions either by clicking on a feature of interest in the image, which will move the stage to the center of the feature, or by clicking one of the 8 buttons in the “Stage Widget” control which moves the stage by user specified increments.

Operate Menu Tab

The Operate Menu (Fig. S1c) gives the user access to common controls used to adjust and display the image, including the “AutoExposure” function. When the AutoExposure is not adequate, the user has multiple options for adjusting the image for optimum viewing.

- When the AutoExposure function is enabled, the image brightness and contrast, as well as the camera frame dwell time, are automatically adjusted for each frame to create an image with optimized contrast.
- When AutoExposure is not enabled, the upper portion of the “Operate” menu allows the user to manipulate the image in various ways: the brightness/contrast can be changed by dragging the cursors displayed on a continuously updated histogram, or by manipulating the brightness/contrast sliders.

- The mapping of the raw image onto the displayed color map can also be adjusted with the “Gamma” slider, or by changing the transfer function from the pulldown menu. Available transfer functions are power, inverse power, square, inverse square, logarithmic and linear. Each selection changes the way the raw image intensities are mapped to the displayed image intensities. The “Negative” option inverts the brightness of the image.
- The “Frames Average” slider allows the user to change the number of frames averaged into each displayed image, allowing the signal to noise of the image to be improved with longer periods of averaging at the expense of increased lag. Images are maintained in a circular buffer, so that as a new image is added to the average, the oldest image is dropped.
- The orientation of the displayed image can be changed by flipping the image up/down, left/right or both – this allows the user to coordinate the image with one taken by a microscope or other imaging device.
- The “Difference” function gives dramatically enhanced contrast for features that are changing in the image. When the Difference button is pressed, the current image is saved, and subsequent images are subtracted from the saved image before display.
- The Reference indicator is an oval feature that is displayed on top of the image. The indicator can be adjusted in position, size and color, for example to match the signature of the beam on the sample surface.

Settings Menu Tab

The Setting Menu (Fig. S1d) allows the user to change calibration and settings values associated with the camera and software.

- Camera settings that can be adjusted include the Frame rate and Frame Dwell time (when AutoExposure is off).
- The image size can also be calibrated so that stage motions accurately correspond to distances on the image.
- A second reference mark (red), the “Beam Position” indicator, can also be positioned on the image from this tab.
- Indicator eccentricity defines the aspect ratio of the reference mark (blue) to represent the actual oval shape of the primary beam.
- The Double Image Correction feature enables an image processing routine to correct for double or ghost images that may be created in the optical path under some conditions. When enabled, a copy of each image is shifted and scaled by the user specified amount, then subtracted from the original image. This operation has the effect of canceling out the “double image” signal.

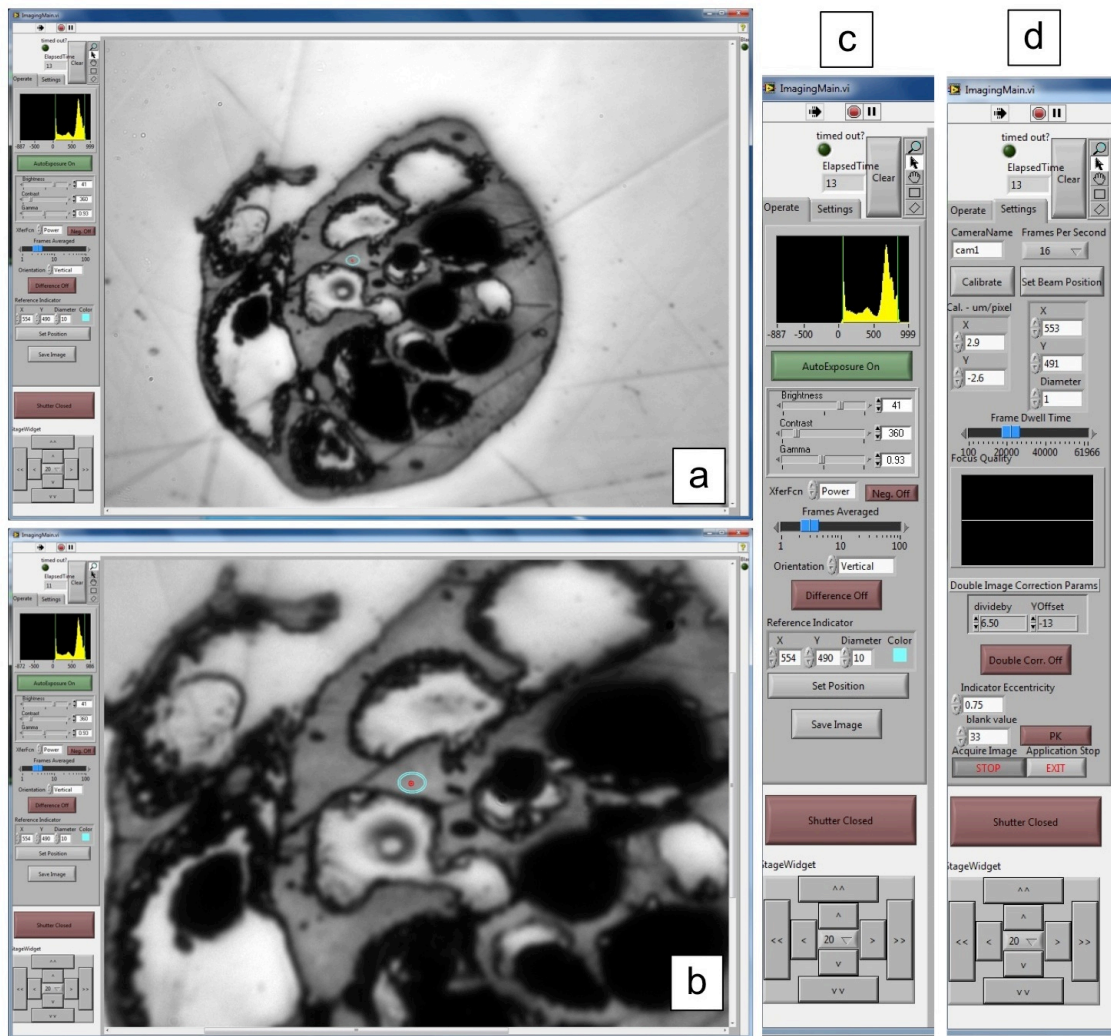


Fig. S1. Badgerscope© Software Package.

- (a) A window showing a sample image and menu window with two tabs (Operate/Setting) on the left.
- (b) Zoomed image of the same sample as (a).
- (c) Expanded view of Operate menu
- (d) Expanded view of Setting menu.