



Using **ZEISS SmartSEM Touch** for Fast and Reproducible Routine Inspection



Seeing beyond

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Date: October 2019

Introduction

The scanning electron microscope (SEM) is the centerpiece of any core microscopy facility in industrial research, academia or routine quality assurance. Extremely high resolution, combined with large depth of field and local assessment of chemical composition mean SEMs are versatile tools, suitable for detailed assessment of almost any sample.

However, any microscope can only be as productive as its user interface allows it to be. Most SEMs are used in multi-user environments, with a small core team of experienced users and several less experienced or even new users.

To get the most out of your SEM, microscope software must be straightforward and intuitive, facilitate reproducible and reliable workflows, but most of all be easy to train your new users. Appropriate control software will decrease your training costs and setup time while increasing your productivity.

We present a case study, showing ZEISS SmartSEM Touch scanning electron microscope control software. In this case study, we carry out an example routine quality assurance task: imaging of damage and debris on a screw thread.

ZEISS SmartSEM Touch

ZEISS SmartSEM Touch is an intuitive and easy-to-use SEM control system. It is currently compatible with the ZEISS EVO and Sigma SEM series, supports multiple languages and can be controlled by any combination of touchscreen,

mouse, keyboard or ZEISS physical control panel for maximum flexibility and best user experience. Easy SEM control is possible without sacrificing the incredible resolution and imaging power of ZEISS EVO and Sigma, Figure 1.

Case Study: Examination of coated screw thread

A proprietary metallic component was examined using ZEISS SmartSEM Touch. This component has several interior screw threads and has a thin protective oxide-based coating on the surface to mitigate erosion, wear and other physical damage. The coating can suffer cracking and wear damage in service, and debris can accumulate on the thread during transport or storage. Depending on debris type and size, it can be harmless or potentially impact further processes. An example screw thread was extracted from a sacrificial sample for routine quality assurance checking.

As SEM time may be limited or many components must be inspected, it is necessary to have a straightforward and consistent workflow.

ZEISS SmartSEM Touch workflow

Taking an image for easy sample navigation takes only a few seconds: after the sample is mounted, the user swings out the navigation camera and a calibrated image is automatically taken, Figure 2. Other photographs or even light micrographs can be used as custom navigation images, depending on the size of features of interest. These are aligned using 3-point registration on known areas of the sample.



Figure 1 ZEISS SmartSEM Touch control system. Example shown is routine simultaneous dual-channel imaging of a coated screw thread using secondary electron imaging and backscattered electron imaging. All parameters are easily controllable by touch, mouse or ZEISS control panel.

We provided SmartSEM Touch with information on sample diameter and height for safe sample navigation. The sample type was selected; this contained an initial set of SEM parameters suitable for the sample type. This study concentrated on dust and debris on the surface, measurement of bulk deformation, and examining cracking in the coating on screw thread teeth. Using ZEISS SmartSEM Touch, all key parameters such as acceleration voltage, Optibeam mode, and chamber pressure can be controlled. Automatic functions were used to easily and accurately set optimal focus, brightness/contrast, lens stigmatism, and alignment. Once the optimal imaging parameters were determined, these parameters were saved as a custom sample type, Figure 3. All future examinations would thus use the same parameters for reproducibility and quick setup.

Imaging the sample under both secondary electron and backscattered electron imaging allowed easy inspection of the surface debris plus differentiation of metallic debris from inorganic and ceramic debris. The debris dimensions were measured in each field of view. The coating was inspected for cracking, and the dimensions of important features (e.g., tooth thickness at tip, or distance between teeth) were measured with appropriate image annotations. Once appropriate settings for image resolution, quality, noise reduction and brightness/contrast histogram correction parameters are obtained, these can then be used automatically for all subsequent saved images. An example is shown in Figure 4.

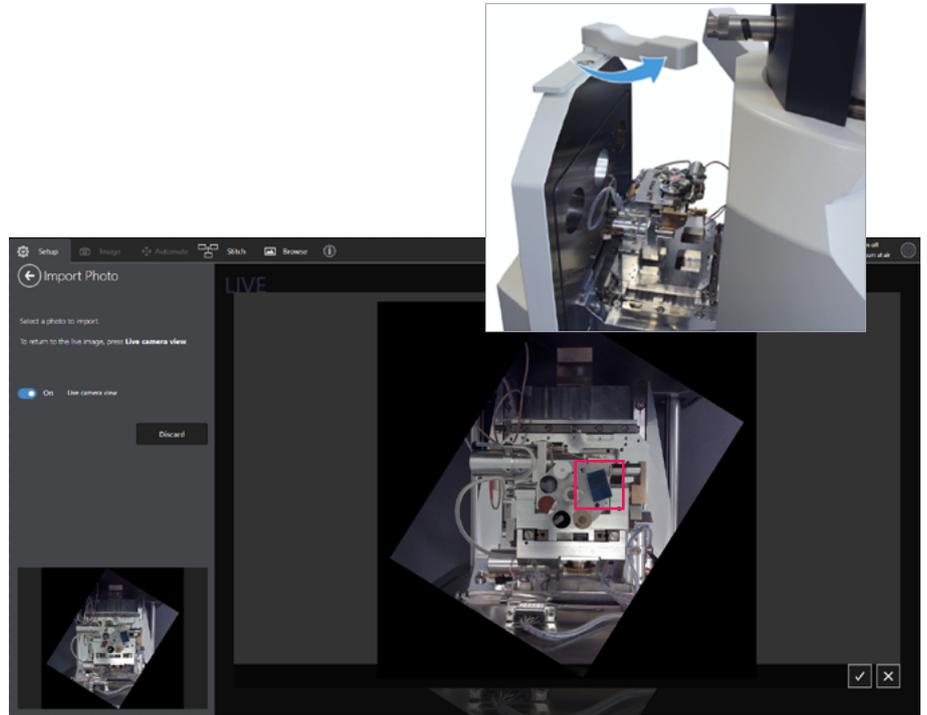


Figure 2 Using ZEISS SmartSEM Touch to obtain a navigation image for multiple samples simultaneously. The screw thread sample is highlighted.

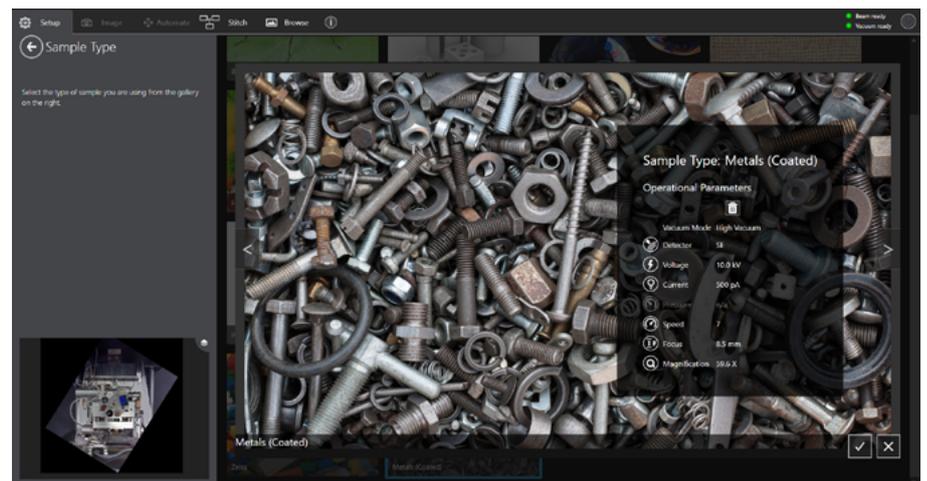


Figure 3 Sample type selection for consistent imaging and rapid setup

To map a large area of the sample, we used the Automate function of SmartSEM Touch. Two main categories of automation are available.

Firstly, a series of points are selected. At each point, images are taken at multiple magnifications. Thus, low-magnification overview shots and multiple higher magnification shots are obtained from the same area.

Secondly, the user can draw a region on their sample (freehand or using predefined shapes), select a magnification, and automatically capture a series of tiled images covering this region. These images can be stitched together to obtain one large, high resolution image of the area of interest, or examined as individual fields. An automation setup mapping several teeth on the screw thread is shown in Figure 5.

Once all relevant micrographs are captured, the data can be viewed in context to fully understand the sample. The Browse function (Figure 6) displays all micrographs in their correct location, scaled relative to any navigation images, with the ability to zoom in and out seamlessly. This includes micrographs taken at different magnifications, with overlapping regions or micrographs taken with different detectors.

Examination of the screw thread confirmed that there are multiple particle and fiber contaminants on the surface of varying sizes. On this sample, almost all particles were the result of atmospheric contamination and

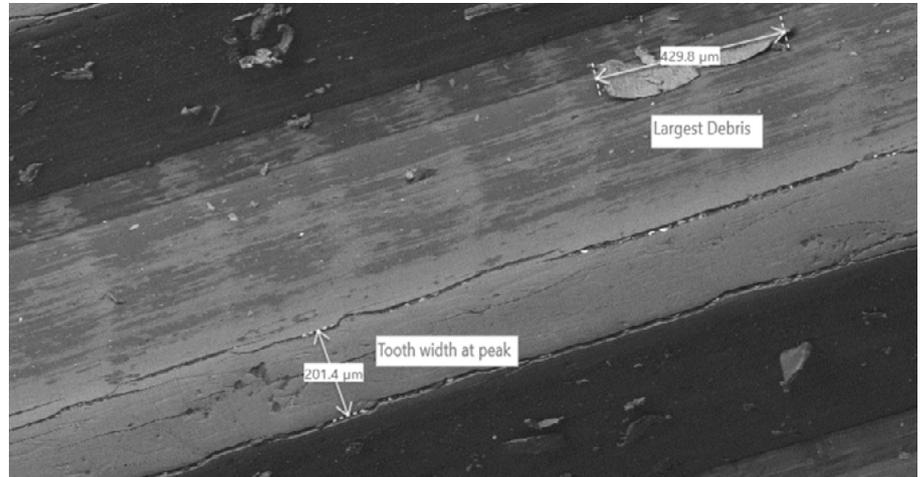


Figure 4 Example image of a region of screw thread teeth. The largest piece of debris in this field is annotated and measured, as is the tooth width. Cracking is visible in the coating on the edging of the screw thread teeth.

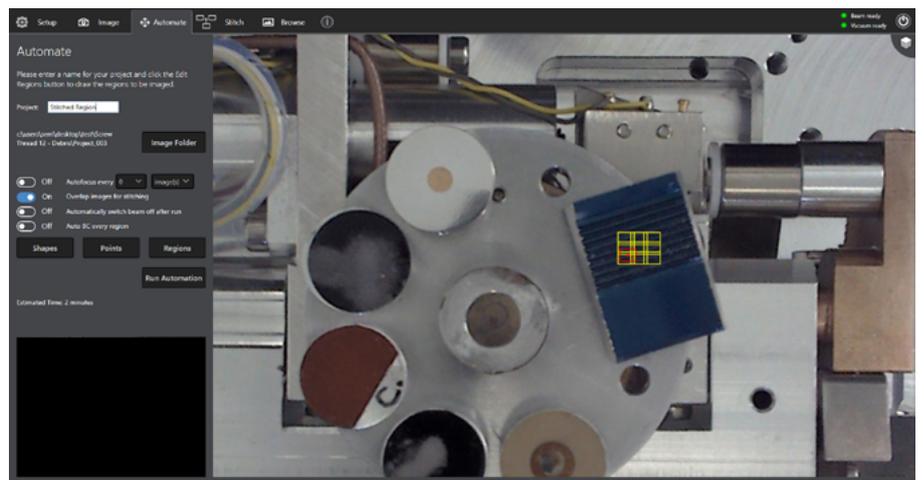


Figure 5 Using the Automation function in ZEISS SmartSEM Touch to map a large sample area.

deposited organic material. In each field of view, the largest debris particle ranged from 400-500 μm. No particles were embedded in the surface and no metallic or ceramic debris was observed. All particles can easily be removed with standard cleaning processes and there are no particular regions of concern.

Cracking was observed, but this was confined to the highest stress/wear regions on the edges of the screw thread teeth. There were no indications of serious wear or grinding marks outside of these areas. There was no indication of deformation or bulk damage to the component.

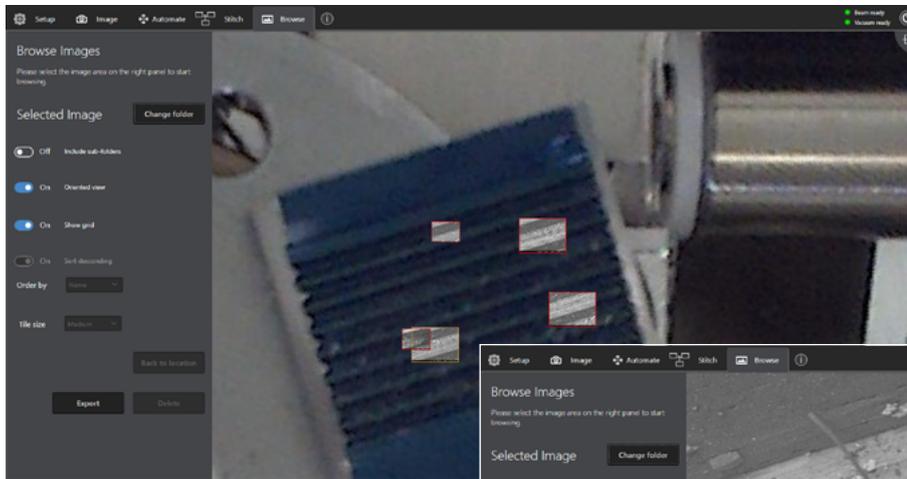
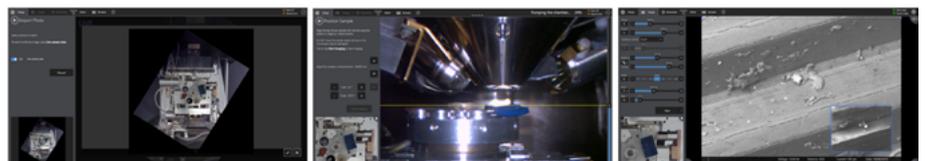
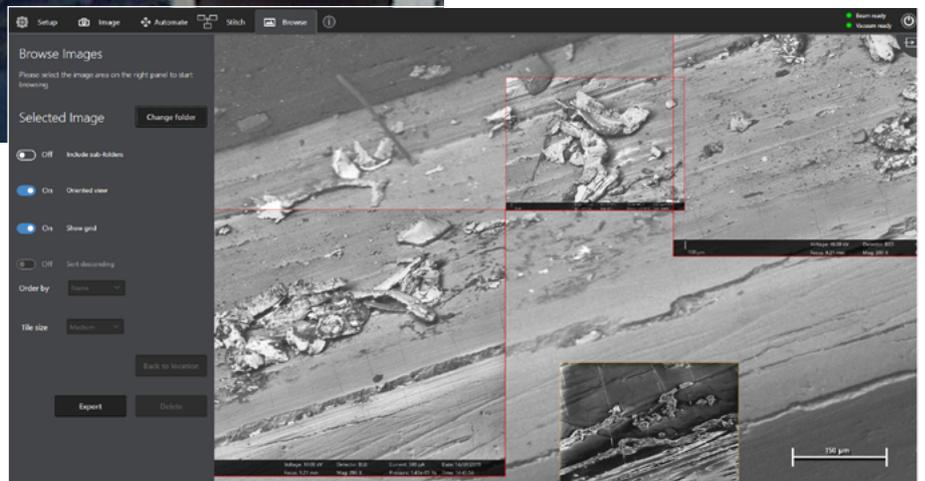
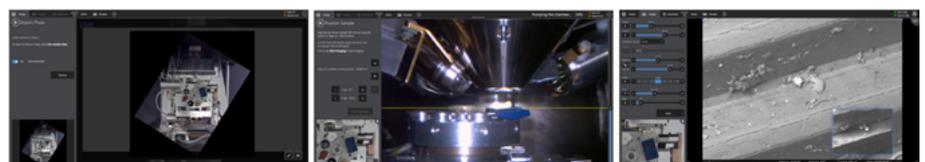


Figure 6 SmartSEM Touch Browse function – showing subsets of micrographs in local context, versus the photographed navigation image, and versus an electron micrograph of a larger area.

Based on the above analysis of a sacrificial sample, this component passed a routine inspection, with no serious issues detected. In this case study, sample setup took only a few minutes, and even this very detailed examination took under an hour. ZEISS SmartSEM Touch is designed such that new users can be trained in under 20 minutes and work efficiently and without supervision, leading to a decrease in training time and costs and an increase in productivity. It can be used for free examination or a workflow can be easily configured for routine and reproducible examination of samples (Figure 7), all without sacrificing the superb imaging power of the ZEISS EVO and ZEISS Sigma scanning electron microscopes.



- 1** Automatically capture a sample navigation image using the built-in Navigation Camera or import your own.
- 2** Load your optimal SEM parameters, and position your sample using the guided workflow for safe navigation.
- 3** Straightforward imaging and measurement with Auto functions and optimized workbench layout.



- 4** Use the Automate function to acquire large area maps or multi-magnification views of areas.
- 5** Seamlessly stitch your images together to create a fully connected data set or single large image.
- 6** Browse, visualize and export your data in context for easy reporting – multiple detectors and magnifications.

Figure 7 Summarized workflow for routine ZEISS SmartSEM Touch operation



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