

## The Real Time 3DSM Solution for the ZEISS GeminiSEM Family

# The Real Time 3DSM Solution for the ZEISS GeminiSEM Family

Author: *Dr. Fang Zhou,  
Carl Zeiss Microscopy GmbH, Germany*

Date: February 2018

The real time 3DSM solution is one of the advanced application features of the GeminiSEM Family. With these FE-SEMs and the aBSD4 backscatter detector you can extend 3DSM functionality to real time surface reconstruction and metrology in a fast and precise way.

Getting a real time 3D image with the 3DSM solution is as easy and direct as taking a 2D SEM image in the usual way. Using 3DSM software in conjunction with a suitably calibrated aBSD4 detector you can obtain a precise quantitative 3D model. The seamlessly integrated metrology software powered by Mountains Technology® provides visualization and analysis of the 3D surface models together with the generation of complete metrology reports.

## 3D surface modeling package

The 3DSM solution from ZEISS uses a four quadrant aBSD4 (angle selective backscatter detector) detector to obtain four individual images taken from four perspectives (cf. Fig. 1). The “shape-from-shading” algorithm reconstructs a 3D model of the surface of an SEM sample. It uses individual images taken by each of the four segments or quadrants of the outer ring of the diode of the aBSD4 detector <sup>[1], [2]</sup>. Images are acquired simultaneously minimizing the influence

of sample drift and making it possible to achieve an accurate 3D surface reconstruction. The resulting 3D image can be visualized in various ways including anaglyph view, mesh view, textured view or contour overlay. The 3D surface modeling package is the ideal solution for obtaining a 3D reconstructed topographical view of the sample surface. Furthermore, it allows to measure surface structures on the sample.

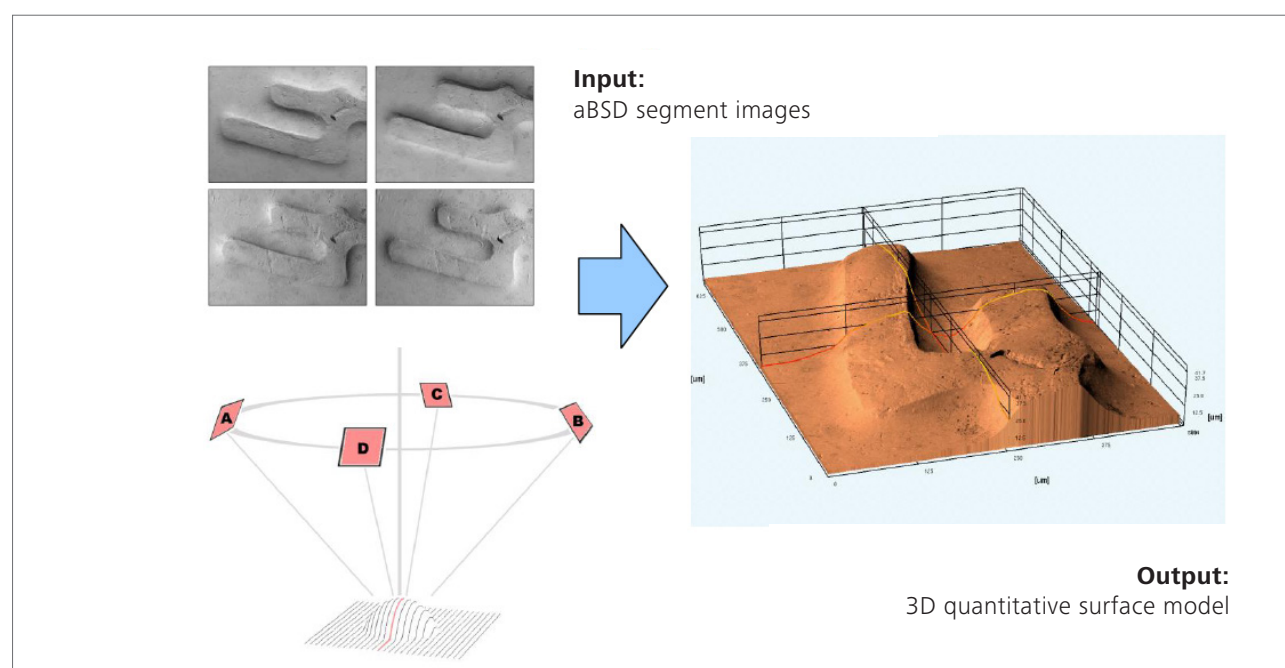


Figure 1 Working principle of the 3DSM method

### 3DSM metrology package

Integrated seamlessly into the 3D surface modeling package, the metrology software is used to visualize and analyze surface topography and to generate detailed surface metrology reports. The 3DSM Metrology package includes the 3D surface modelling package and additionally the metrology software which is powered by industry-standard Mountains Technology® from Digital Surf [3].

Key features of software are:

- Real time visualization of 3D surface topography at any zoom level and angle with user definable rendering and height amplification.
- Image enhancement and data correction filters, advanced roughness/waviness filtering techniques (ISO 16610), MATLAB™ compatibility option for user-defined filters.
- Geometric analysis (distance, angle, area, volume, step heights) of 3D surfaces and extracted 2D profiles.
- Surface texture analysis including 3D and 2D parameter sets supporting the latest ISO standards (including ISO 25178) and national standards (DIN, ASME, JIS, GB/T, etc.).
- Extraction and analysis of sub-surfaces in exactly the same way as full measured surfaces.
- Colocalization of SEM images (secondary electrons and back-scattered electrons) and other 2D SEM images of the sample.
- Colocalization of SEM images with surface topography measured by AFM, areal 3D optical microscope or profilometer, including 3D overlays (may require hardware upgrades).
- Generation of visual surface metrology reports including analysis workflow, “Minidocs” library of common sequences of analysis steps, and automated analyses of series of surfaces.
- Intuitive user interface in ten languages including simplified Chinese, Japanese and Korean.

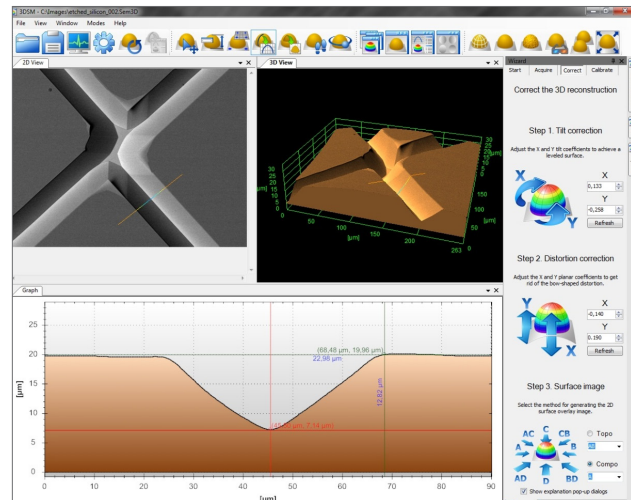


Figure 2 GUI of the 3DSM software. Basic surface analysis functions are available.

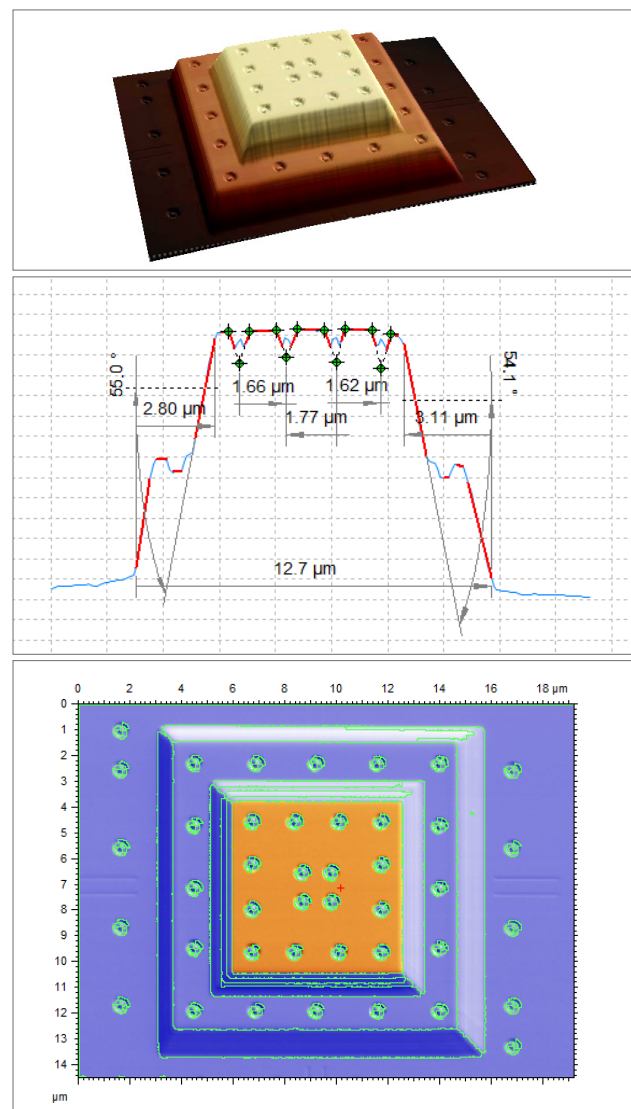


Figure 3 Mountains Software from Digital Surf [3], example of 3D analysis of reconstructed structure

## Key benefits

### 3DSM

- Quantitative 3D model for further metrology
- Accuracy of the height measurement is about 1% of Field of View (FOV)
- Real time 3D model (aBSD4 detector required)
- 3D model update in less than 2 seconds (including acquiring images and reconstruction)
- Insensitive to sample drift, weak charging and material differences
- Detector calibration is not required (only factory calibration required)
- 3DSM software has basic metrology functions

### 3DSM metrology

- Seamless integration of industry-standard Mountains® software.
- High quality 3D visualization of surface topography in real time.
- Quality control of surface texture and surface geometry in accordance with the latest standards and methods.
- Smart multi-language user environment for fast, automated surface metrology report generation with full metrological traceability.
- Correlation of 2D images and 3D topography data in mixed microscopy environments (SEM, AFM, light microscope).
- Upgradable, expandable metrology solution with numerous options including contour analysis and grains & particles analysis.

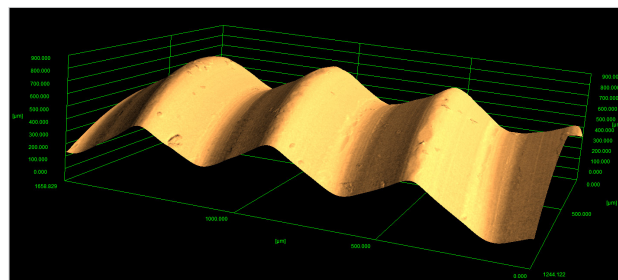


Figure 4 Surface of a screw, an example of surface structure of large sample feature

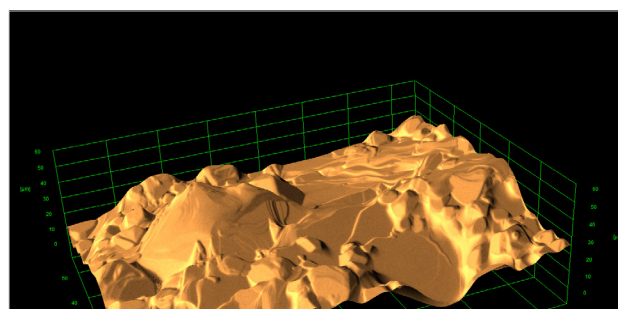


Figure 5 Surface of Ceramics

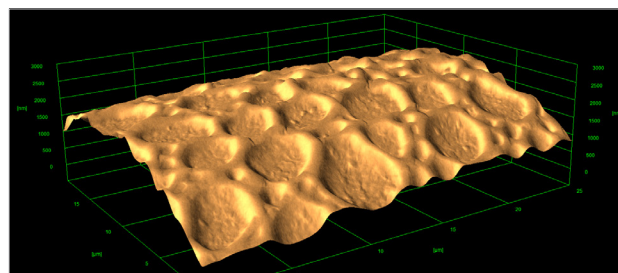


Figure 6 Pollen grains of an Amaryllis

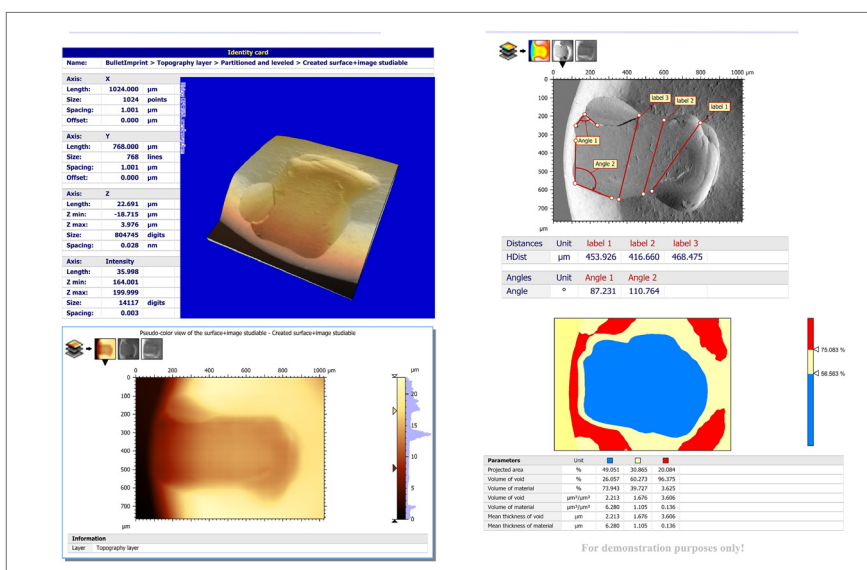


Figure 7 Example of surface measurement report

**Remarks**

The 3DSM solution is a powerful tool for viewing and measuring 3D surface features that have dimensions in the range 1–1000  $\mu\text{m}$ . For users that need highest precision 3D metrology the SEM/AFM hybrid solution <sup>[4]</sup> from ZEISS delivers 3D information down to atomic level. Mountains<sup>®</sup> metrology software allows to obtain topographical information from the micrometer scale to the sub-nanometer scale.

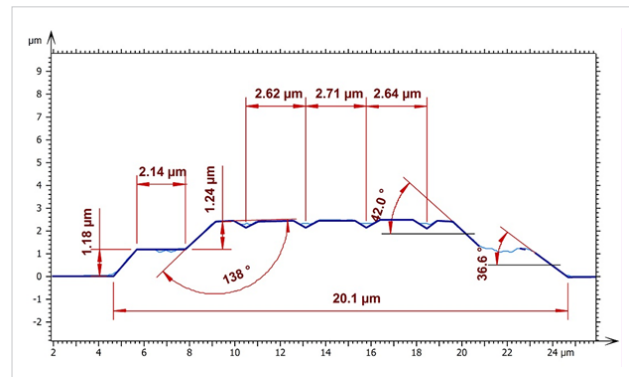


Figure 8 Example of measurement report

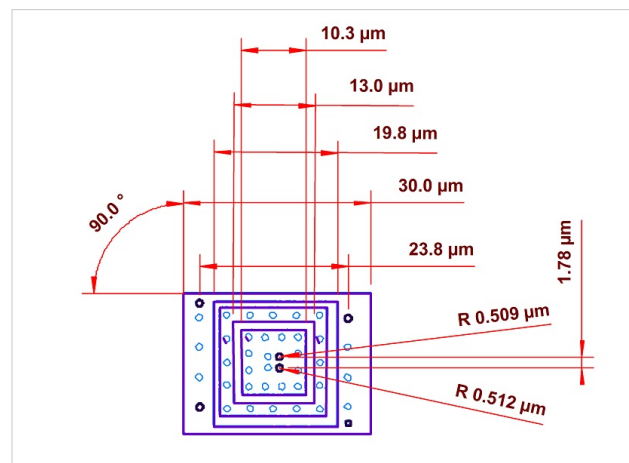


Figure 9 Example of measurement report

**References:**

- <sup>[1]</sup> 3DSM – 3D surface Modeling (White paper) Jaroslaw Paluszynski, Benjamin Tordoff, Michael Schweitzer, 2012
- <sup>[2]</sup> 3DSM – 3D Surface Modeling (White paper) Jaroslaw Paluszynski, 2010
- <sup>[3]</sup> Digital Surf Web Page <http://www.digitalsurf.com>
- <sup>[4]</sup> ZEISS Integrated Atomic Force Microscope. online(02.16.2018):  
[https://applications.zeiss.com/C125792900358A3F/0/619BEFAFC5D51373C1258152003B1B5A/\\$FILE/EN\\_42\\_011\\_230\\_AFM\\_rel1\\_0.pdf](https://applications.zeiss.com/C125792900358A3F/0/619BEFAFC5D51373C1258152003B1B5A/$FILE/EN_42_011_230_AFM_rel1_0.pdf)



**Carl Zeiss Microscopy GmbH**  
07745 Jena, Germany  
microscopy@zeiss.com  
www.zeiss.com/microscopy



Not for therapeutic, treatment or medical diagnostic evidence. Not all products are available in every country. Contact your local ZEISS representative for more information.  
EN\_42\_013\_094 | CZ 02-2018 | Design, scope of delivery and technical progress subject to change without notice. | © Carl Zeiss Microscopy GmbH