

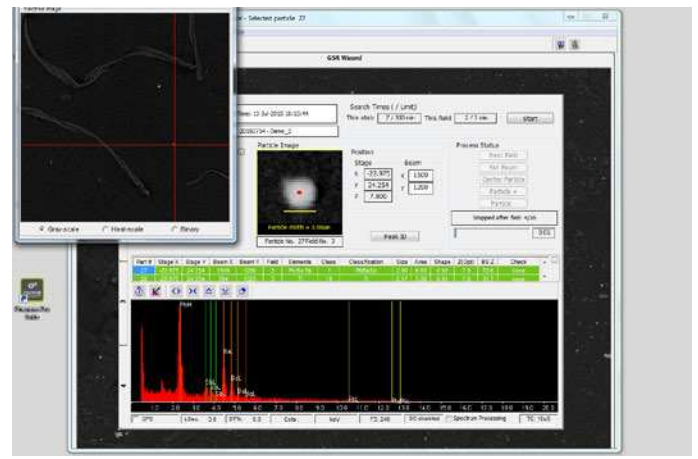
Phenom GSR Desktop SEM

Automated gunshot residue analysis on a desktop SEM





A weapon being fired



GSR user interface

Unique: Phenom GSR on a desktop SEM

Gunshot Residue (GSR) analysis plays an important role in the determination if a firearm has been used in a crime. Established GSR analysis techniques are based on the use of a scanning electron microscope (SEM), which is used to scan the sample and find suspect GSR particles. If a suspect particle is found, an Energy Dispersive Spectroscopy (EDS) technique is used to identify the elements in that particle. Most common search criteria are the presence of Pb, Sb, and Ba. However, detection of Pb-free primers, such as Ti and Zn, is a requirement as well.

Thermo Scientific™ Phenom GSR is the world's first desktop SEM that can run automated GSR analysis. It is based on the Phenom XL desktop SEM. Both software and hardware are fully integrated to enhance user-friendliness, reliability and analysis speed.

The Phenom GSR Desktop SEM comes with the following items:

- Automated Gunshot Residue analysis and classification software package
- Integrated BSED and EDS detector
- Calibration sample

The Phenom GSR desktop SEM is equipped with a CeB6 source that enables stable operation and has a typical operational life time of >1,500 hours, which is ideal from a usability, serviceability and uptime perspective. With a loading time of less than 1 minute and its fast stages, the Phenom GSR is the ideal tool for highly automated applications, such as automated gunshot residue analysis.

Imaging Specifications

Imaging modes

Light optical	Magnification range: 3 - 16x
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Electron optical	<ul style="list-style-type: none"> • Magnification range: 80 - 100.000x • Digital zoom max. 12x
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Illumination

Light optical	Bright field / dark field modes
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Electron optical	<ul style="list-style-type: none"> • Long lifetime thermionic source (CeB₆) • Multiple beam currents
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Acceleration voltages	<ul style="list-style-type: none"> • Default: 5 kV, 10 kV and 15 kV • Advanced mode: adjustable range between 4.8 kV and 20.5 kV
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Vacuum levels	Low - medium - high Medium or high is recommended for GSR analysis
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Resolution	≤ 14 nm
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Detector

Standard	Backscattered electron detector
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Optional	Secondary electron detector
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Digital image detection

Light optical	Proprietary high resolution color navigation camera, single shot
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Electron optical	High-sensitivity backscattered electron detector (compositional and topographical modes)
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Image formats

JPEG, TIFF, BMP

Image resolution options

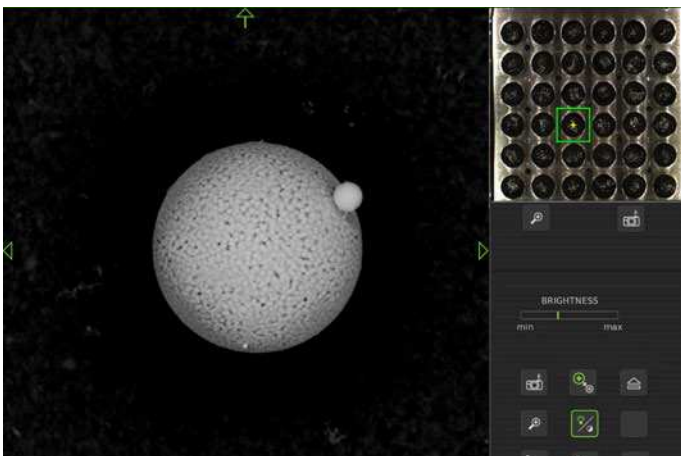
456 x 456, 684 x 684, 1024 x 1024 and 2048 x 2048 pixels

Data storage

USB flash drive, Network, ProSuite PC

Sample stage

Computer-controlled motorized X and Y



Stainless steel nanoparticle

This desktop SEM can also be used for many other forensics applications, such as ballistics, paint analysis and fiber characterization. Moreover, the Phenom GSR is easy to set up and transport and can be relocated without difficulty. The system does not require any special facilities, such as compressed air, chillers, liquid nitrogen, EM shielding, cooling water, and has a low CO₂ footprint (energy usage of maximum 300 Watt).

High throughput, reliable results

Thanks to the fully motorized stage the Phenom GSR can handle a scan area of 100 mm x 100 mm. The software uses the internal scan control of the SEM. This enables more accurate beam positioning which especially helps when revisiting the particle in the GSR verification phase. A standard GSR sample holder, which is in the form of a removable tray, can hold 30 standard pin stubs. This holder also contains a motorized height functionality, which allows the GSR software to maintain an optimal working distance while doing the analysis.

GSR software is based on a four-step wizard to consistently set up the software in order to receive fast and reliable results from each run. The wizard is highly intuitive and allows the user to analyze multiple samples automatically. Both EDS results and SEM images are stored for all detected particles, and the software allows the user to quickly and easily revisit each particle to validate results. The software also offers extensive reporting capabilities. The GSR software complies with the current ASTM E1588 standard guide for GSR and is equipped with the standard layouts as provided by ENFSI.

Fully integrated EDS

Energy Dispersive Spectroscopy (EDS) allows users to analyze the chemical composition of their samples. Detailed chemical composition can be obtained from a micro volume via a spot analysis. Elemental distribution can be visualized with the elemental mapping option.



Sample holder with up to 30 x 12 mm pin stubs

Sample Holder for Phenom GSR

Sample Holder for Phenom GSR

Standard	Motorized height sample holder (Z) in form of removable tray
Optional	4-axis eucentric motorized sample holder

Sample size

- Max. 100 mm x 100 mm (up to 30 x 12 mm pin stubs)
- Max. 40 mm (h) with motorized sample holder

Scan area

100 mm x 100 mm (motorized)

Sample loading time

Light optical	< 5 s
Electron optical	< 60 s

Classification Software Specifications

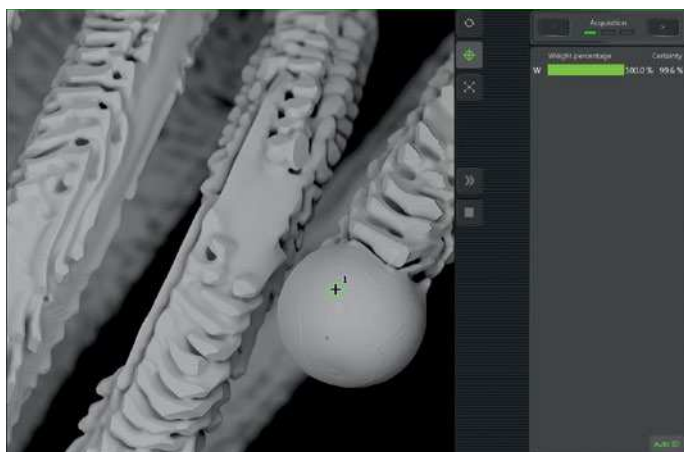
Automated gunshot residue analysis

- Four-step wizard
- Compliant with ASTM E1588-16
- Typically ≤ 98% hit rate on plano artificial GSR sample
- Compliant with ENFSI Best Practice Guidelines 2006
- Extensive reporting capabilities
- Supports manual revisiting and validation of particles

Step-by-step data collection

The dedicated software package Element Identification (EID) is used to control the fully integrated EDS detector. This EID software is standard delivered as part of the Phenom GSR product. Analysis has become as easy as imaging, since there is no need to switch between external software packages or computers. The CeB₆ electron source in the Phenom is used to generate the highest X-ray count rate in its market segment, allowing fast results.

The EID software package allows the user to identify nearly all materials in the periodic table, starting from Boron (5) and ranging up to Americium (95). It is a perfect analysis tool for a wide range of samples and applications. Projects can be stored locally or on the network, where they can be analyzed at a later stage or offline.



Acquisition

The EID software package runs smart algorithms with advanced peak analysis to optimize the auto-identification functionality, while still allowing for manual adjustments by the user at any time in the analysis process. The intuitive step by step process within the software helps the user to collect all X-ray results in an organized and structured way.

EDS Specifications

Detector types

- Silicon Drift Detector (SDD)
- Thermoelectrically cooled (LN₂ free)

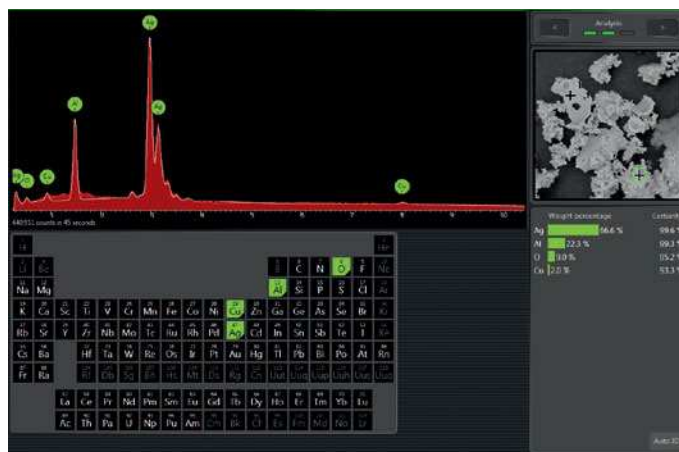
Detector active area	25 mm ²
X-ray window	Ultra thin Silicon Nitride (Si ₃ N ₄) window allowing detection of elements B to Am
Energy resolution	Mn Kα ≤ 132 eV
Processing capabilities	Multi-channel analyzer with 2048 channels at 10 eV/ch
Max. input count rate	300.000 cps
Hardware integration	Fully embedded

Software

- Integrated in Phenom ProSuite
- Integrated column and stage control
- Auto-peak ID
- Iterative strip peak deconvolution
- Confidence of analysis indicator
- Export functions: CSV, JPG, TIFF, ELID, EMSA

Report

Docx format



Spot mode analysis

System Specifications

Dimensions & weight

Imaging module	316(w) x 587(d) x 625(h) mm, 75 kg
Diaphragm vacuum pump	145(w) x 220(d) x 213(h) mm, 4.5 kg
Power supply	156(w) x 300(d) x 74(h) mm, 3 kg
Monitor	375(w) x 203(d) x 395(h) mm, 7.9 kg

- ProSuite
- Standard ProSuite System including: 19" monitor with PC and network router mounted
 - 375(w) x 250(d) x 395(h) mm, 9 kg

Requirements

Ambient conditions

Temperature	15°C ~ 30°C (59°F ~ 86°F)
Humidity	< 80% RH
Power	Single phase AC 110 - 240 Volt, 50/60 Hz, 300 W (max.)

Recommended table size

150 x 75 cm, load rating of 150 kg