GEMINI® Multi-Mode STEM Detection System

Product Information

Introduction

By using a STEM (Scanning Transmission Electron Micro-scopy) detector the information limit for the GEMINI® FE-SEMs can be extended beyond the nanometer range. A resolution of 0.8nm at 30kV is now readily attainable and gives additional nano-scale information. The resolving power of the GEMINI® FE-SEM can be used to save processing time on TEM systems for high resolution applications and enables high sample through-put for quality assu-rance applications and routine type measurements.

Typical application fields are:

- Materials analysis (polymer, ceramics, nanoparticles)
- Semiconductors (FIB lamellas from devices)
- Life science (histology, pathology)

The classical STEM detector, used since the SEM was introduced, consists of a single detector area positioned under a replica or thin section. This would either provide BF (Bright-field), DF (Dark-field) or the unwanted sum of both signals, which could surpress essential information. The newly developed proprietary GEMINI® Multi-Mode STEM detection system delivers enhanced image quality by real-time simultaneous detection of BF, DF, and orientated DF signals, without realignment at any position.

GEMINI® Multi-Mode STEM

The GEMINI® Multi-Mode STEM detection system comprises two parallel diode detector surfaces. The DF detector surface has been divided into specific areas to allow orientated DF imaging. The specimens are mounted in a carrousel type TEM grid holder, which holds 6 specimens. The GEMINI® Multi-Mode STEM detector includes a complete retractable assembly with high precision adjustments for optimum alignment and can be used in combination with all GEMINI® detectors.

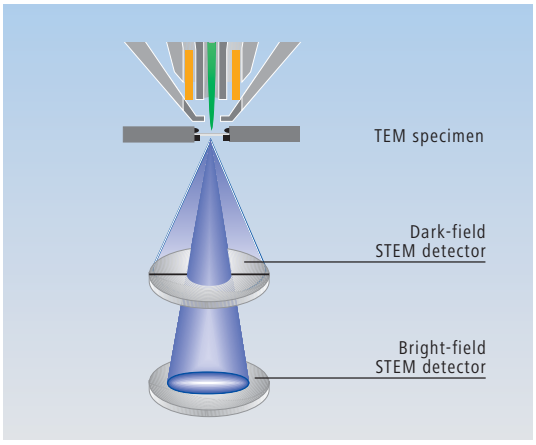

Fig. 1: STEM detector assembly.

The GEMINI® Multi-Mode STEM detector is available for the current SUPRA® FE-SEM, ULTRA FE-SEM and CrossBeam® range. In line with our philosophy to support existing systems the GEMINI® Multi-Mode STEM detector is also compatible with the previous 1500 uniplinth series GEMINI® FE-SEMs. Furthermore it can also be used on the multi-purpose EVO®40, EVO®50, and 1400 uniplinth series (with limited resolution due to the W/LaB_6 emitter).

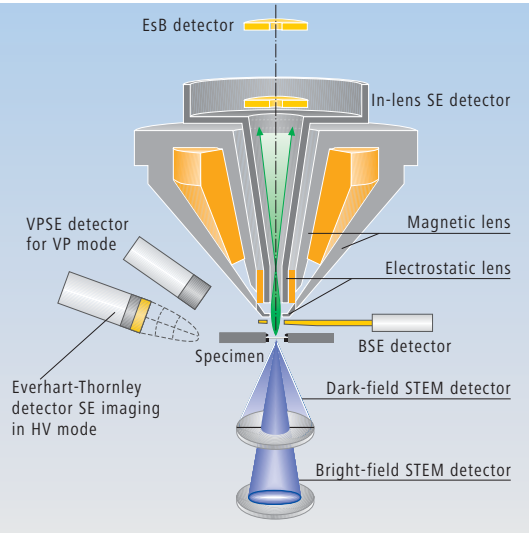

Fig. 2: Detector systems for the GEMINI® FE-SEM.

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We make it visible.

The new STEM detector is a further addition to the unique range of GEMINI® detection systems to enable full imaging and analysis of nano-structures.

Advantages of the Multi-Mode STEM detector

- Simultaneous imaging of BF and DF
- Orientated DF mode (ODF)
- STEM resolution down to 0.8 nm at 30 kV
- Ease of use with high precision positioning
- Long-life diode detector system
- Imaging of stained and unstained samples
- Imaging of non-conducting specimens in SUPRA® VP mode
- STEM mode EDX resolution down to 30 nm or less

Signal Enhancement

Due to the significantly lower electron beam energies used in the SEM, the beam-specimen interactions are much stronger. This enables the possibility to explore subtile contrast mechanisms.

The STEM detector enables pure BF or DF imaging to achieve optimum contrasts and rich imaging details of even unstained thin sections. Furthermore it also allows EDX analysis of particles down to 30 nm or less.

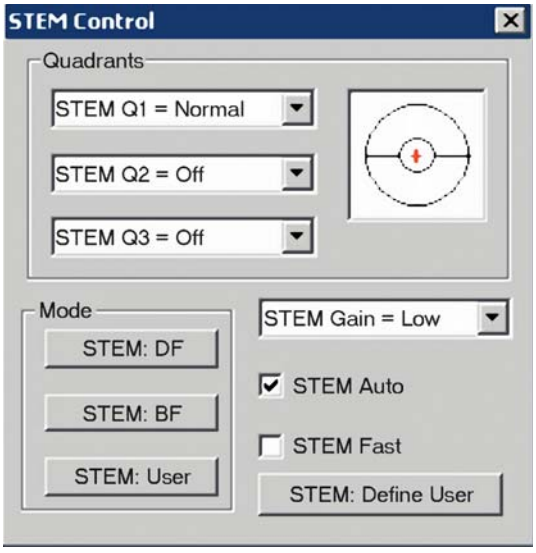
The unique parallel STEM detector arrangement allows simultaneous imaging and mixing of BF, DF and orientated DF STEM signals on any position of the TEM specimen without realignment. The GEMINI® Multi-Mode STEM detection system allows the following six imaging modes:

- BF
- BF and DF added
- DF
- BF and DF subtracted
- ODF
- ODF1 and ODF2 subtracted

Specifications	
Detector Type	Solid state diodes
Imaging Modes	Bright-field, Dark-field, and orientated Dark-field
Image Processing	Real-time Mixing, Normal, Inverse
WD Detector	8 mm +/-1 mm
WD Sample	2 – 5 mm
Detector Assembly	Fully retractable
Sample Holder	6 TEM grids on carrousel

System Control

Operation of the GEMINI® Multi-Mode STEM detection system and signal processing is controlled by an additional menu embedded in the SmartSEM® graphical user interface.



The STEM control enables direct selection of DF, BF or ODF signal in normal or inverse mode. The STEM User mode allows user defined configurations to be stored and selected.

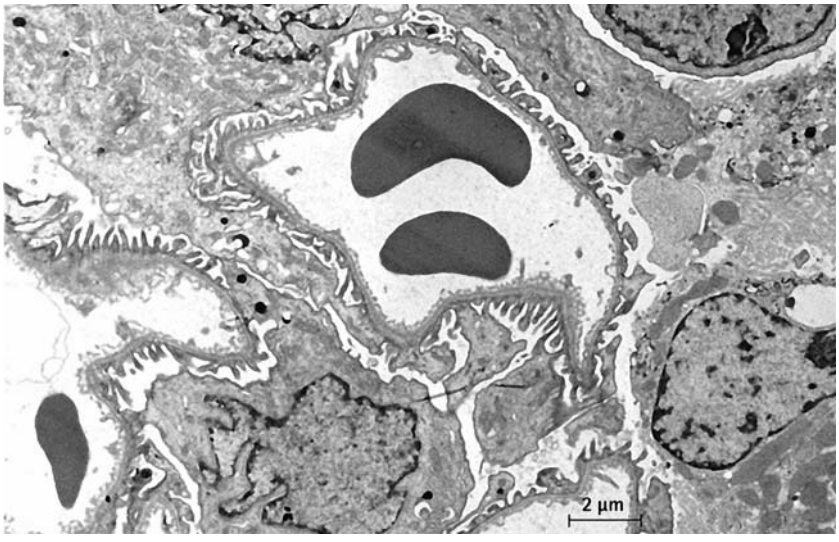


Fig. 4:
High contrast imaging on a typical stained thin liver section (30kV).

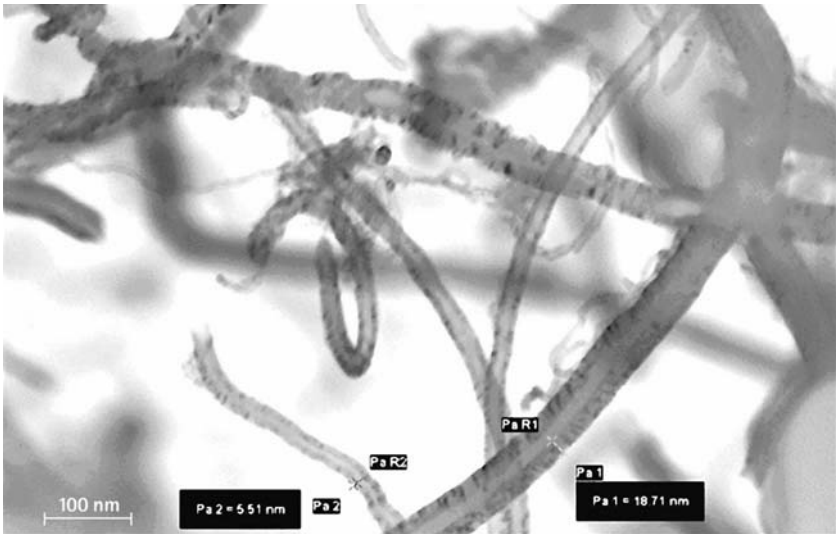


Fig. 6:
Ni solid solution in single wall nanotubes (30kV).

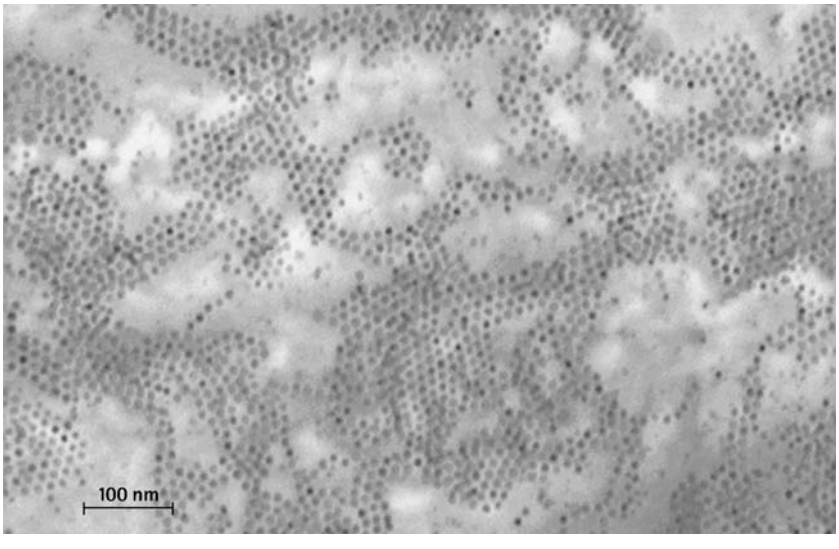


Fig. 8:
Magnetic cobalt nano particles in oil acid (Olefine), combined orientation enhanced DF + BF image mode (27kV).
Since the magnetic vector deflects the electron in different directions you see bright and dark contrast depending on this vector (similar to Zeemann effect).

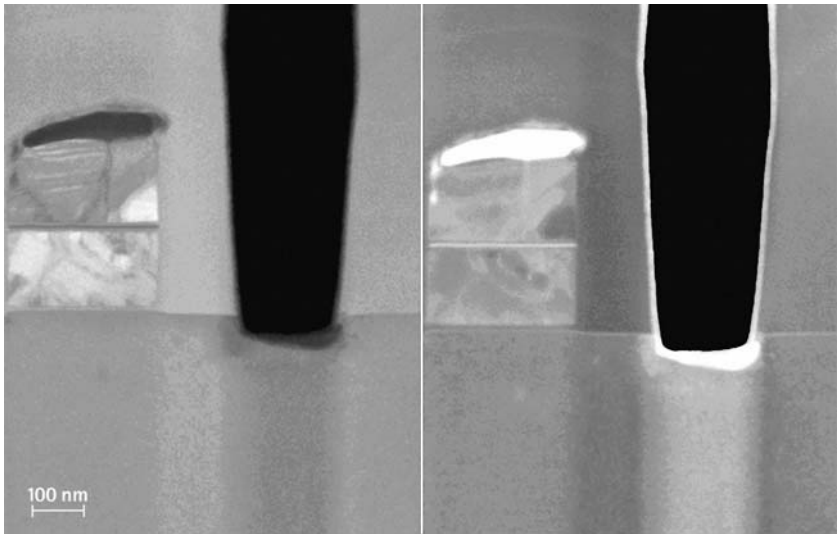


Fig. 5:
BF and DF image of a semiconductor showing fine orientation contrast and high contrast of oxide and nitride layers.

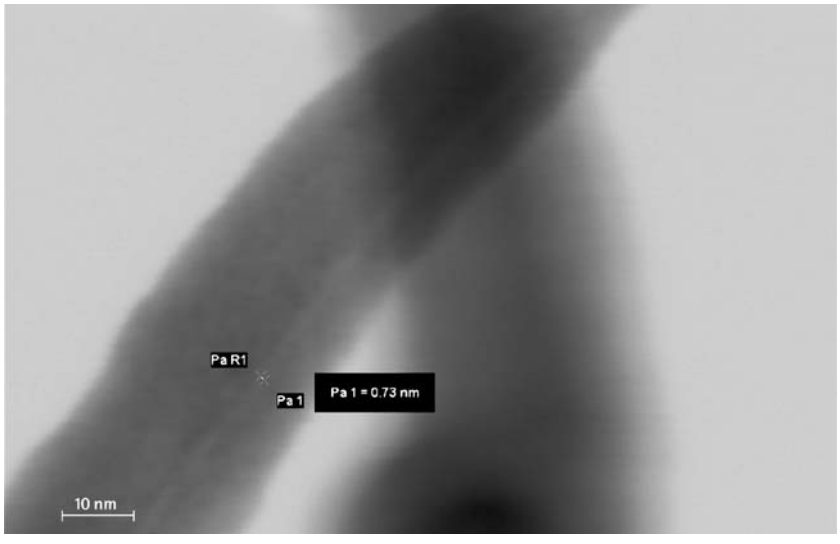


Fig. 7:
Resolution performance on single wall nanotubes charme with ca. 0,7 nm dimension (30 kV).

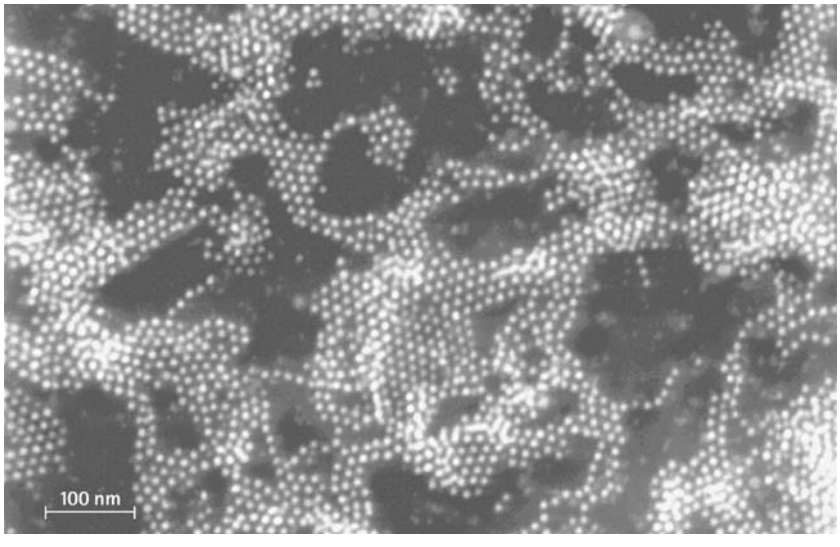


Fig. 9:
Same sample, same position as Fig. 8, but only DF mode (27 kV).

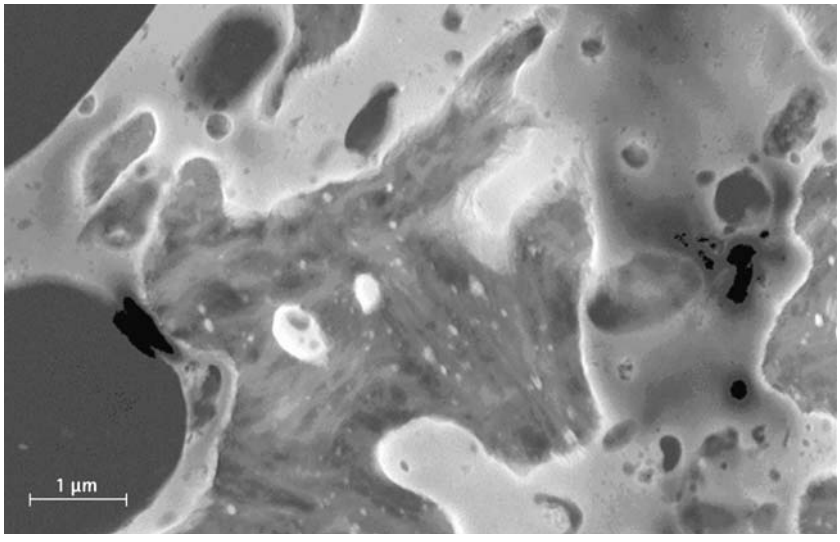


Fig. 10:
DF image of multiphase polymer (PE with buthadene / isoprene at 20kV).

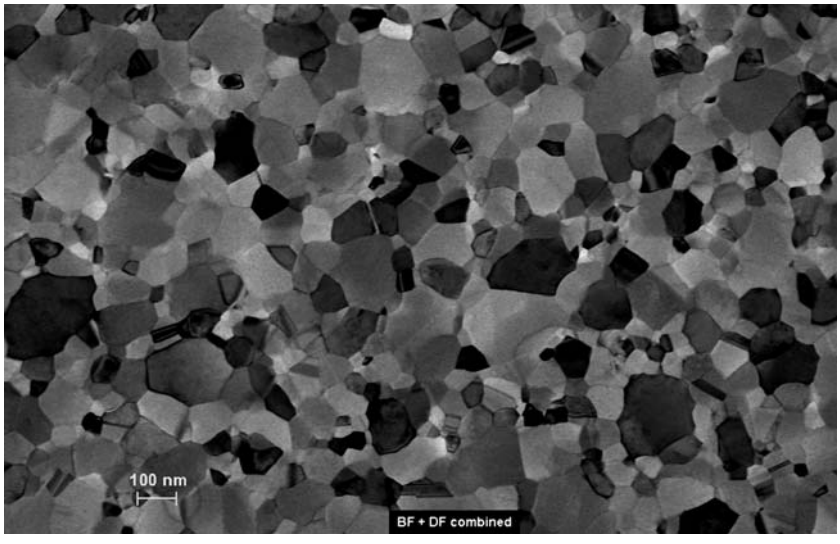


Fig. 11:
Combined BF and DF signal of aluminium sample (30kV).

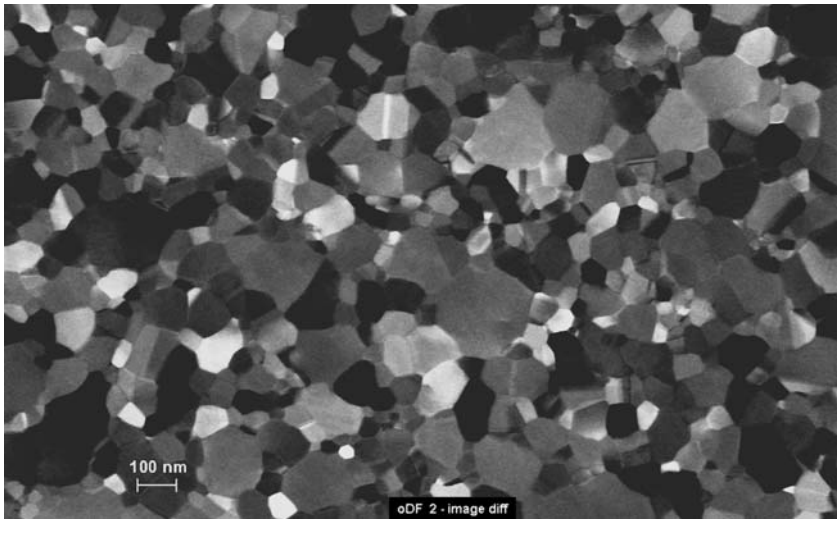


Fig. 12:
Same sample, same position as above with ODF2 differentiated signal which clearly shows twins in some of the crystals (30kV).

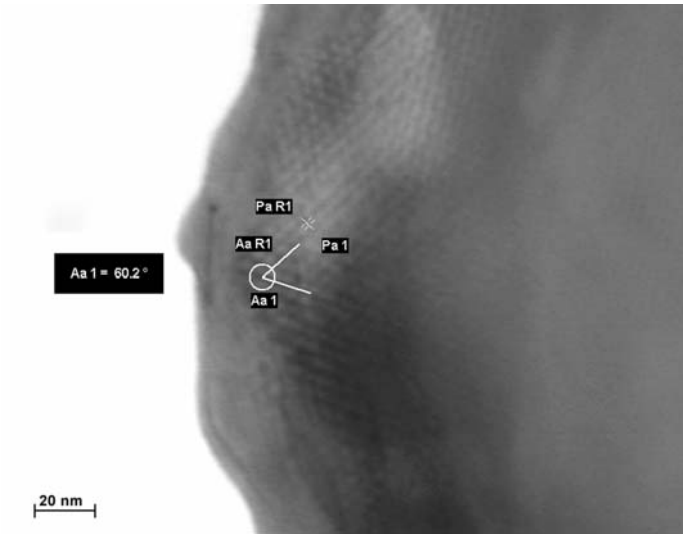


Fig. 13:
High resolution STEM image of mica at (30 kV).

Maximum Information – Maximum Insight

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Our mission at all times: Maximum Information – Maximum Insight.

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