

# MAIA3

Ultra-High Resolution at Low Voltages



 **TESCAN**  
PERFORMANCE IN NANOSPACE



MAIA3 from TESCAN is a newly developed analytical scanning electron microscope which demonstrates ultra-high resolution of 1 nm at 15 kV. The resolution performance at 1 kV is 1.4 nm using secondary electrons and 0.8 nm at 30 kV in STEM mode. This powerful instrument is based on TESCAN's proven three-lens column equipped with a Schottky field emission gun.

The spectacular resolution at low voltages is achieved by the unique construction of TESCAN's 60 degree immersion objective lens which decreases optical aberrations dramatically compared to a conventional lens. An additional intermediate lens can operate simultaneously with, or instead of, the objective lens providing the possibility of multiple display modes.

### Introducing MAIA3 Technology Advantage

The specimen observed in MAIA3 is totally immersed in the strong magnetic field induced by the immersion objective lens, which extends into the specimen chamber. The objective lens is narrower than a conventional non-immersion objective and thus provides even more space around samples.



### Key Features

Users benefit from the improved working conditions provided by MAIA3 in the following ways:

- **Ultra-High Resolution of 1 nm at 15 kV and 1.4 nm at 1 kV**  
Ultra-high resolution of the MAIA3 FE-SEM at low accelerating voltages can be further combined with TESCAN's Beam Deceleration Technology to reach extreme resolution. Additionally the field of view and the range of working distances are extensive.
- **Low Landing Energy 50 eV**  
Beam Deceleration Technology enables ultra-low electron landing energy imaging with automation down to 50 eV and manual control all the way down to 0 eV.
- **A Wide Range of Display Modes**  
TESCAN optics includes an intermediate lens which operates in addition to the objective lens to make a wide range of display modes possible. RESOLUTION mode immerses the sample in the magnetic field for the ultimate resolution, FIELD mode provides large field of view while the sample remains free of any magnetic field and DEPTH mode displays the image with increased depth of focus.
- **In-Beam Secondary and Backscattered Electron Detectors**  
The detection system consists of TESCAN's proprietary detectors, In-Beam SE, In-Beam BSE as well as SE in Beam Deceleration Mode, all of which are placed inside the column to provide a variety of signals in addition to the standard SE, BSE or STEM detectors placed in the specimen chamber.
- **High Probe Current and Short Analytical Working Distance**  
MAIA3 allows high probe currents up to 200 nA which are suitable for all analytical techniques such as EDX, WDX, EBSD, CL, etc. All of these detectors are optimized to operate at an analytical working distance of 5 mm which is short enough to ensure excellent resolution for analysis.
- **In-Flight Beam Tracing™**  
Very accurate real-time computation of working distance, magnification and all optical parameters together with continuous control of the beam spot size and beam current is ensured by In-Flight Beam Tracing™ technology; a method originally developed by TESCAN.
- **Automated Procedures and User-Friendly Software**  
Fast and efficient microscope control with many automated functions (e.g., focusing, stigmation, brightness, beam centring, spot-size optimization, auto-diagnostics) and software extensions (image processing, 3D scanning, correlating position with micrograph or light optical image, etc.) enables truly intuitive user-friendly operation. TESCAN software allows the user easily, or fully automatically, to select the most suitable detector according to the scan mode.

## ■ E-beam Lithography with Ultra-Short Dwell Time Down to 20 ns

Draw Beam software delivers CAD like drawing of all required shapes and together with ultra-fast scanning it provides a flexible tool for fast and efficient e-beam lithography.

## ■ Analytical GM Chamber

There are 3 chamber sizes available for MAIA3: LM (large), XM (extra-large) and GM (giant). All MAIA3 chambers provide superior specimen handling using a full 5-axis motorized compucentric stage and ideal geometry for EDX and EBSD.

The GM chamber enhances the analytical potential of the MAIA3 FE-SEM. The GM chamber not only allows the user to observe very large samples up to a weight of 8 kg (18 lbs) but it also provides more than 20 free ports for various detectors and analysers such as EDS, WDS, EBSD and also allows all detectors and techniques to point to the common analytical working point.

## ■ Decontaminator Option

SEM observation of specimens at low kV tends to be adversely influenced by hydrocarbon contamination. This undesirable deterioration in imaging performance can be significantly reduced by the use of an integrated decontaminator. The MAIA3 FE-SEM is designed especially for ultra-high-resolution imaging at low voltages; therefore the decontaminator is a highly recommended option.

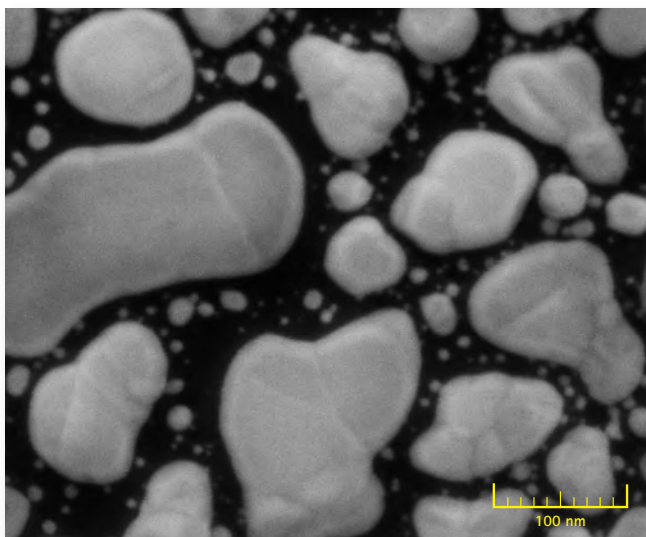


Fig. Gold on Carbon, In-Beam SE detector, SEM HV (BDM) 1 kV, RESOLUTION mode, particle size range from 5 to 150 nm.

## Applications

Charging of non-conductive materials, observation of very thin layers, damaging of sensitive samples – these are the problems which many scientists are faced with using scanning electron microscopy in biology, bioengineering, nanosensor or semiconductor research. The MAIA3 is the perfect choice for these applications and can provide an effective solution for environmental studies and particle analysis.

## Materials Science

Due to the interaction volume, which increases with the energy of the landing electrons, it is often necessary to use low accelerating voltage in order to observe very fine surface details. The MAIA3 FE-SEM, which offers excellent resolution at low kV, represents a significant advance in the examination of tiny surface features, nanolayers and various types of nanostructures. It is also suitable for observation of beam-sensitive and non-conductive samples in their natural (uncoated) state (e.g. ceramics, polymers, glass, fabrics, etc.).

## Engineering

The MAIA3 FE-SEM can be effectively utilized in the semiconductor industry (inspection of integrated circuits, observation of ultrathin sections of semiconductors, solar cells, nanosensors, etc.). It is also particularly important to examine the products of bioengineering and electron beam lithography.

## Lithography

The ultra-high resolution MAIA3 FE-SEM is a powerful tool for use in the field of electron beam lithography. Furthermore, the MAIA3 FE-SEM is especially suited to imaging of sensitive resists, which are prone to high-energy beam damage.

## Life Science

The MAIA3 FE-SEM with ultra-high resolution at the lowest kV can effectively be used for observation of samples in their natural state without using conductive coatings (e.g. bio-sensors, STEM histology and pharmaceuticals).



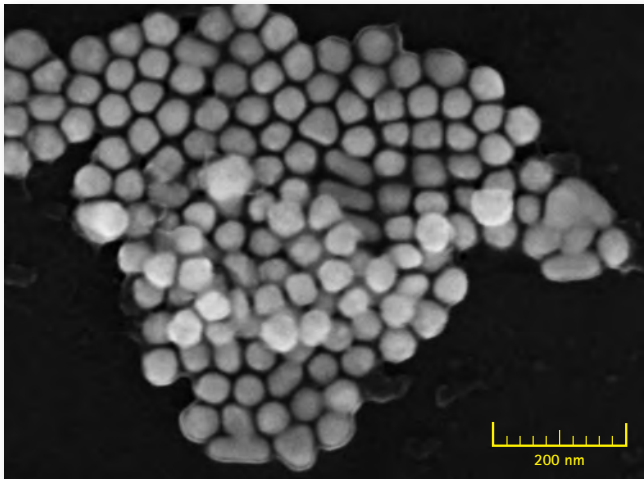


Fig. Au nanoparticles (40 nm) in sol gel on Si substrate, In-Beam SE detector, SEM HV 15 kV, RESOLUTION mode.

The sample was provided by courtesy of University of Toulone, France.

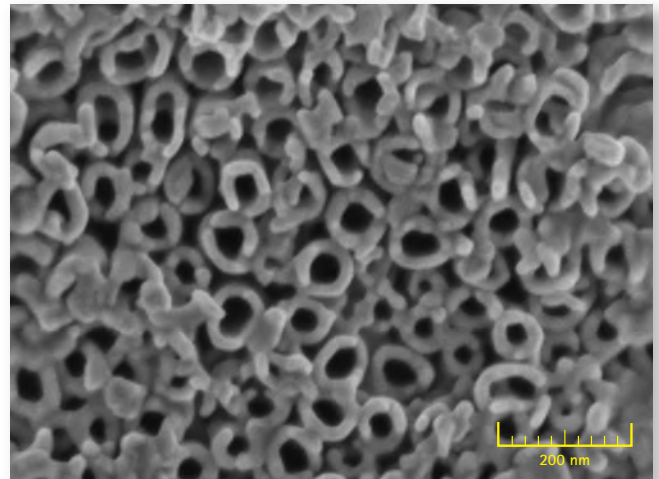


Fig. TiO<sub>2</sub> nanotube arrays, In-Beam SE detector, SEM HV (BDM) 1 kV, RESOLUTION mode.

TiO<sub>2</sub> is used for instance in photocatalysis, dye-sensitized solar cells, and biomedical applications.

## Technical specifications

Resolution	1 nm at 15 kV (In-Beam SE) 1.8 nm at 1 kV (In-Beam SE) 2.5 nm at 500 V (In-Beam SE) 1.4 nm at 1 kV (Beam Deceleration) 2.2 nm at 200 V (Beam Deceleration) 0.8 nm at 30 kV (STEM)
Accelerating voltage	200 V to 30 kV / down to 50 V with BDT option
Probe current	2 pA – 200 nA
Chambers	LM, XM, GM
Sample size	Observable diameter up to 180 mm (chamber dependent)
Scanning speed	From 20 ns – 10 ms per pixel adjustable in steps or continuously
Field of view	4.3 mm at WD <sub>analytical</sub> 5 mm
Chamber vacuum	High Vacuum Mode <math> < 9 \times 10^{-3} \text{ Pa} </math> * Low Vacuum adjustable 7–500 Pa **

\* pressure <math> < 5 \times 10^{-4} \text{ Pa} </math> reachable  
\*\* with low vacuum aperture inserted



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