

Schlumberger Cambridge Research



Environmental Scanning Electron Microscope



Features

The Environmental Scanning Electron Microscope at Schlumberger Cambridge Research is an XL30 FEG manufactured by FEI. The Environmental SEM retains all of the performance advantages of a conventional SEM, but removes the high vacuum constraint on the sample environment. Wet, oily, dirty, non-conductive samples may be examined in their natural state without modification or preparation. The ESEM offers high-resolution secondary electron imaging in a gaseous environment of practically any composition, at pressures as high as 50 Torr, and temperatures as high as 1500°C with the hot stage accessory. In addition to the imaging capabilities the instrument also has an X-ray detector and EDAX Genesis Spectrum software for elemental analysis/mapping. A micromanipulator stage is also available for modifying the sample within the vacuum chamber. Using this stage, liquid reagents can be injected onto the sample for the direct imaging/analysis of reactions.

Detailed Descriptions

FP 6632/47 ESEM-FEG

The ESEM-FEG scanning electron microscope is a Schottky-based FEG system with 3 imaging modes: high vacuum (10⁻⁴ mBar), low vacuum (1 mBar) and environmental (10 mBar). The system can be used for imaging and microanalysis of conducting or non-conducting samples whether they are high vacuum compatible or not. The field emission gun contains the emitter tip, suppressor, extractor and first condenser lens integrated into a single unit. The column is electro-magnetically aligned and supported by extensive software for ease of operation. A six position strip aperture allows a high range of beam currents, easy selectable with a click-stop mechanism. The resolution of the system is 2 nm at 30 kV in all modes of operation. The system comes with a standard Everhart-Thornley detector for operation in high vacuum, a large field detector for low magnification imaging in low vacuum mode and a patented gaseous secondary electron detector (GSED) for optimum operation in environmental mode.

The specimen chamber has an internal diameter of 284 mm, has six free ports and can hold either a 50 x 50 mm or 100 x 100 mm x/y stage. The motorized stage is supported by extensive software for control, storage of positions and functions such as comp-eucentric rotation. The system is equipped with an oil diffusion pump system and two rotary pre-vacuum pumps. In addition, the gun section is pumped by a two-stage ion-getter pump and separated from the chamber by an automatically operated column isolation valve. Patented ESEM® multiple differential vacuum system allows high pressures in the sample chamber while maintaining high vacuum for the electron gun. Specimen exchange is within a few minutes by means of a draw-out stage. Control of the vacuum and pump down cycle is fully automatic and includes procedures for flushing the chamber. In both low vacuum and environmental mode the chamber is filled with water vapor as standard. Auxiliary input and pressure control of other gases is possible. The system is equipped with a clean desk and completed with a computer, mouse, keyboard and LCD screen. It makes use of the Windows NT operating system and the SCSI communication protocol. Extensive functions for column alignment and parameter control make the system very easy to operate. The microscope is supplied with comprehensive operation instructions (comprehensive service manuals are optionally available), various keys, special tools, vacuum test pieces, a set of vacuum seals, Fomblin high-vacuum grease, lamps and fuses.

Detailed Descriptions

FP 6800/73 50 x 50 mm 4-axes Motorized Stage

A high-precision, eucentric tilt specimen stage with motorized X, Y, Z and rotation. Control and readout of these movements as well as readout of manual tilt adjustment operates via the XL Graphics User Interface. The stage has the following movements:

- X,Y range = 50 mm
- Z range = 25 mm external adjustment range and 25mm internal adjustment range
- Tilt range = -15° to $+75^{\circ}$ at 10 mm FWD with readout directly on front panel scale and via GUI
- Rotation = continuous.

The stage has high precision in terms of backlash, cross talk and flatness.

FP 6741/30 ESEM Wide-angle Option

This option includes two ESEM detectors:

- A version of the Gaseous Secondary Electron Detector (GSED) with a bore of 1 mm, which is larger than- standard. This GSED easily interchanges with the standard GSED.
- An ESD detector with pressure limiting aperture (PLA) of 1 mm that extends into the chamber and is used for optimization of EDX geometry.

Both detectors increase the maximum field of view of the standard instrument to around 1 mm, so that the minimum available magnification is reduced by a factor two compared with the standard detector to 125x.

The maximum specimen chamber pressure with wide-angle detector option installed is 7 mbar (5 Torr).

FP 6762/31 Feedthrough & Cooler for Peltier or Heating Stage

Chamber feedthrough plate for Peltier and heating stages for water connections, thermo-couple connections and power connections. The feedthrough is mounted on the lower left port of the specimen chamber. Supplied with the feedthrough is a re-circulating fluid chiller to circulate temperature-controlled water through the stages, and a flow controller to safeguard against flooding of the specimen chamber.

Detailed Descriptions

FP 6752/33 XL30 ESEM Heating Stage for up to 1000 °C

This high temperature stage fits directly onto the stage of the XL30 ESEM using a special mounting bracket and is used in conjunction with the FP 6762/31 feedthrough and cooler and the FP 6753/30 temperature controller.

The stage is designed to heat samples in a small, 5 mm diameter ceramic crucible. The stage has an integral heat shield to limit radiant heat loss and protect the EDX detector.

A ceramic Environmental Secondary Detector (ESD) is supplied with the stage and is installed to replace the GSED if the stage is operated above 500 °C. If the stage is operated at a temperature above 700 °C for a period exceeding 15 minutes, it must be cooled by water.

The stage requires water cooling to be provided by the FP 6762/31 feedthrough and cooler, the chamber feedthrough plate being designed to fit on to the lower left-hand port and to provide the water feedthrough and electrical connections for the stage. The hoses of the heating stage prohibit the use of the stage rotation.

The stage temperature is software-controllable over the whole range up to 1000 °C, using controller FP 6753/30. There is an integral heat shield (to be used at temperatures exceeding 400 °C) to retain the heat and protect the EDX detector.

FP 6753/30 Temperature Controller for Heating Stage

Temperature Controller to be used with the FP 6752/33, FP 6752/40 or FP 6754/33 heating stage mounted in combination with FP 6762/31 feedthrough & cooler mounted on the ESEM chamber.

The heating stage temperature controller is a free-standing unit that stands on the microscope desktop.

There are manual controls for setting the temperature to a resolution of 1°C. Alternatively, it can be software-controlled with operation embedded in the XL control and with temperature display in the image databar.

Microprocessor control allows the user to program a heating profile with up to 5 different ramp and soak rates.

Detailed Descriptions

FP 6750/35 Peltier-cooled Specimen Stage for XL30 ESEM

and moistening of the specimen. The specimen temperature control stage uses the Peltier effect to cool or heat the specimen electrically through a range of 20 °C above or below the ambient temperature. The achievable temperature range can extend from -20 °C to +50 °C, a special antifreeze fluid being required.

The system is supplied with a microprocessor-controlled power supply providing set-point temperature control and LED read-out to 0.1 °C.

The stage module mounts quickly and easily on the ESEM sub-stage. The sample is held in a stainless steel cup approximately 8 mm in diameter. Fluid circulated through the heat sink transports heat to or from the system as required to maintain equilibrium.

The accessory requires the chamber feedthrough FP 6762/31, which is used for providing fluid and electrical connections.

The FP 6750/35 Peltier stage mounts directly on the 50 mm stage, allowing XYZTR movement, with the extent of rotation being limited by the water cooling and electrical cable connections. The Peltier stage uses the same chamber feedthrough plate as the high temperature stage. The manual controller for the Peltier stage is standing free on the microscope desktop.

FP 6761/35 CCD IR Inspection Camera

The camera is an accessory, which is fully integrated into the microscope. The camera uses four light emitting diodes to illuminate the sample and chamber, and an infrared camera to form the image.

Mounted with the illuminators in a housing fitting on Port N on the specimen chamber, the camera views the sample from the rear of the chamber and allows observation of the sample over the entire range of motion of the stage. A camera electrical interface box is mounted on the rear of the specimen chamber.



Detailed Descriptions

FP 6751/30 Micro Manipulator / Micro Injector

This micro manipulator/ micro injector is an accessory for XL ESEM systems with 50 mm stage. It fits on the stage door and provides:

- External control for specimen manipulator
- External syringe for fluid injection onto specimen.

This accessory allows the user to manipulate the sample mechanically with a needlepoint, or to maneuver

a fine tube close to the sample to inject fluids or gases onto the sample surface. The device is manually operated from outside the chamber.

The accessory fits onto port F of the 50-mm stage, and is not compatible with 100 mm and 150 mm stage

doors. When it is mounted on the stage, the specimen current feedthrough is removed and the specimen is earthed internally.

The micro-manipulator/micro-injector can be used with solid-state BS detector; if a Centaurus (or Robinson) BS detector is present this must be retracted and out of use due to mechanical interference with the detector's light guide.

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- Automatic or manual energy calibration with resolution calculation;
- KLM line markers and peak labeling;
- Automatic and manual peak identification;
- User definable spectral windows or regions of interest;
- Full digital rate meter function;
- Spectrum comparison with normalize, add, subtract and multiply functions;
- Escape peak subtraction;
- Peak generation;
- Manual and automatic segmented Kramer method for background modeling;
- Visual halographic peak deconvolution;
- Completely standard-less quantification;
- Choice between ZAF and PhiZAF matrix correction;
- Full capability for analysis using pure element standards, compound standards or partial standards;
- JOB mode for automatic analysis sequences;
- Including direct microscope control, such as for stage, BS detector;
- On-line help.



Detailed Descriptions

9432 909 96942 EDX Multi-element Mapping

Comprehensive software package for collection and display of video (SE, BSE etc.) and/or X-ray signal data. Collected images can be displayed on the monitor, printed or archived on disk. A maximum of 15 Xray signals can be recorded simultaneously in addition to a video image such as from a back-scatter detector. Maximum image collection resolution is 4000 x 3200 and the package includes extensive possibilities for image enhancement as well as pre-viewing of up to 48 images simultaneously for easy retrieval of stored data.

PV 9760/81 CDU-UTW Detector Unit

Si(Li) type EDX detector with robust Ultra-Thin Window for detection of all elements down to Carbon. Resolution of 132 eV or better. Active detector area is 10 mm². The crystal is automatically protected against warm-up. A warm-up does not affect the performance so cooling is only necessary when the detector is to be used. Includes pre-amplifier, amplifier, cables and 2.5-liter Dewar left empty when not in use.