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High Temperature BSE Detector

Electrode-based sensor technology for in-situ microscopy

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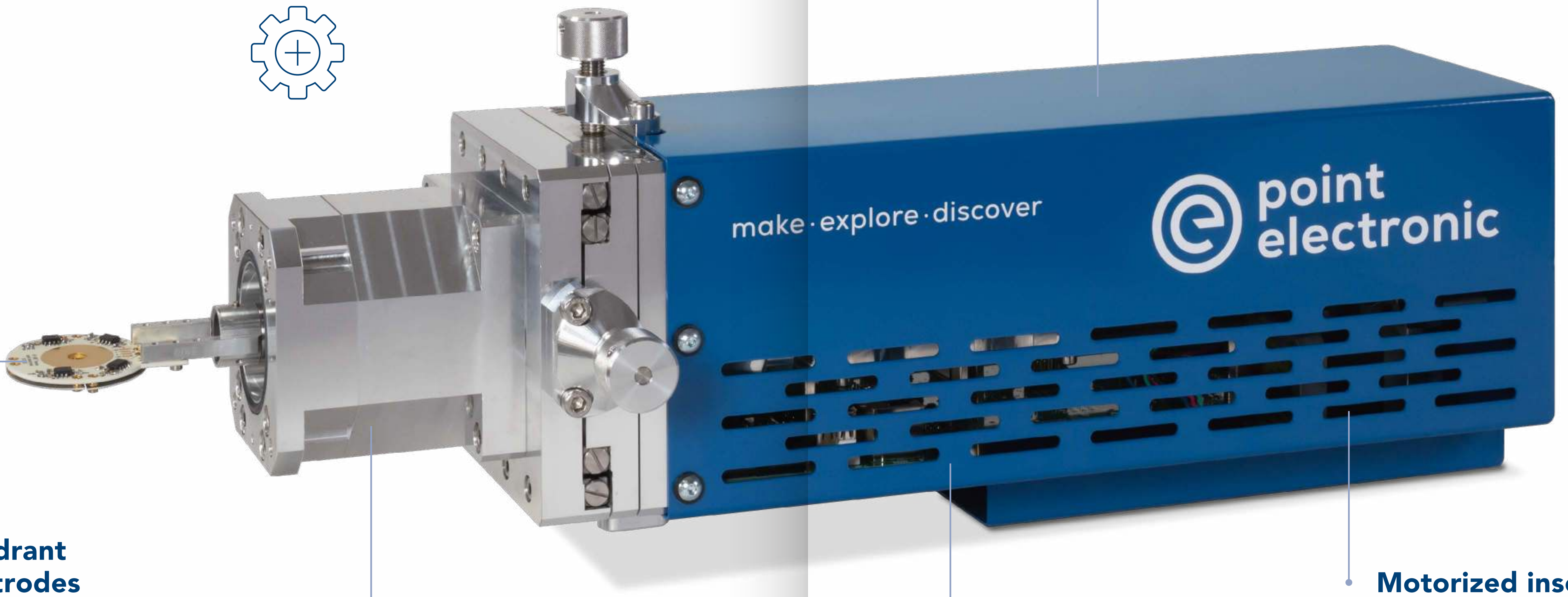
Electrode-based detector

To unlock the potential of advanced high-temperature in-situ microscopy, we combined bespoke electronics, mechanics and software for a calibrated 4Q detector.



Calibrated amplification

Two-stage amplification for each of the four electrodes, with independent and calibrated controls for brightness and contrast

Quadrant electrodes

Backscattered electrons are collected using light-blind electron sensors in four-quadrant geometry

Galvanic isolation

Bias voltage is applied to the electrodes to enhance or inhibit detection of low energy electrons

Standard interfaces

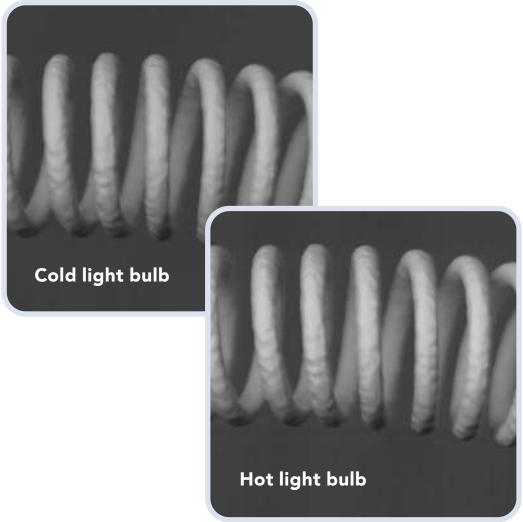
Control over USB 2.0 and analog video signals output on RJ45 connectors for modular system integration

Motorized insertion

Port-mounted and bellow-sealed with motorized insertion/retraction, high-precision XYZ alignment and touch alarm

Quantitative in-situ experiments

Image and measure surfaces at high-temperatures, in the presence of environmental gasses

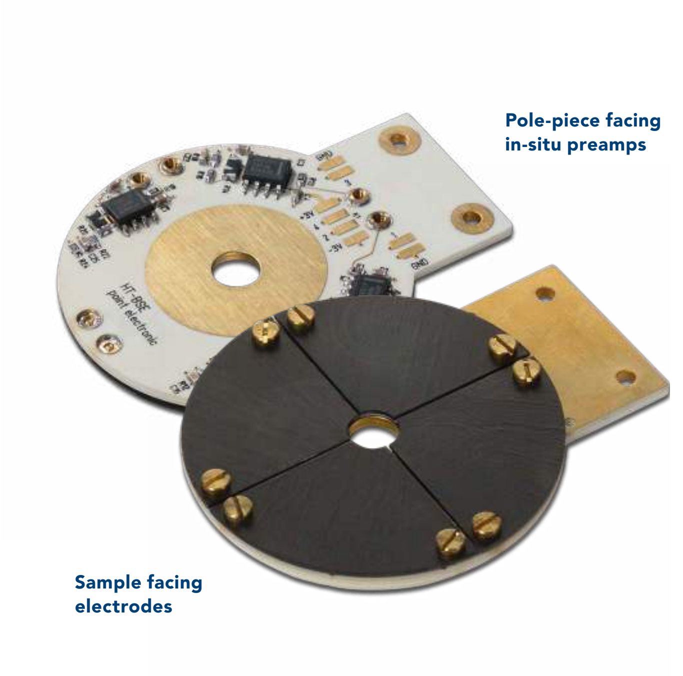


High temperatures

- Electrodes are blind to light emitted by hot samples
- Thermal electrons are filtered using the detector bias
- Maximum temperature limited only by radiative heating
- Compatible with laser heating

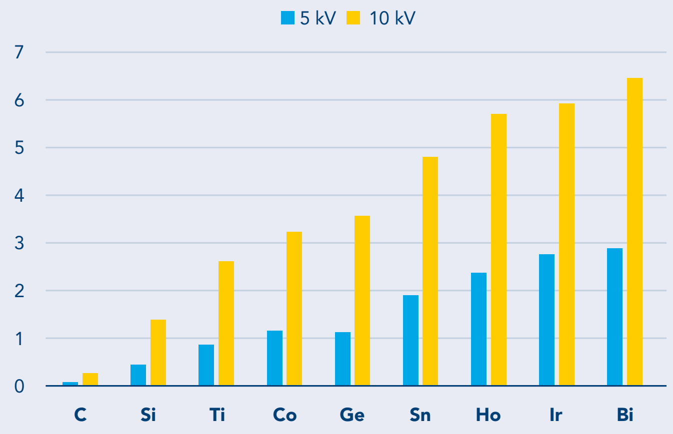
Quadrant electrodes

- Four metal electrodes with carbon coating
- Each electrode with own in-situ preamplifier
- Adjustable bias voltage applied to all
- Size and geometry adapted to SEM model



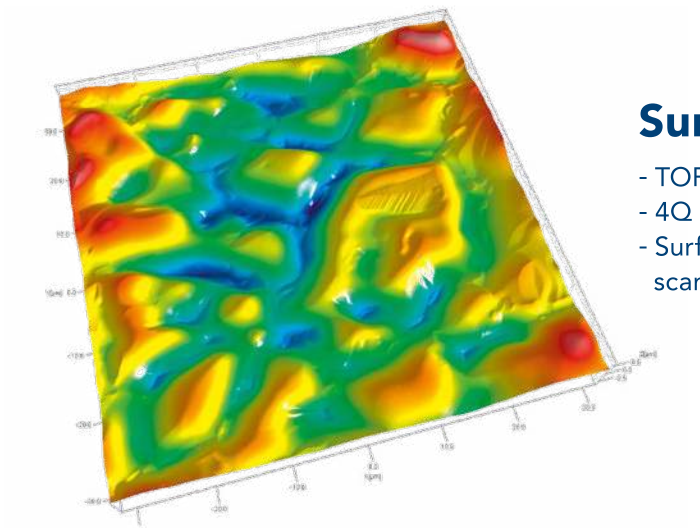
Quantitative measurements

- Electronic gains, offsets and bias are factory calibrated
- Amplification is temperature stabilized
- Current collected into sensing electrodes is measured when combined with calibrated scan controller for SEM (DISS6) and COMPO calibration sample



Easy to clean

- Entire detector front end is easily removed
- Electrodes can be cleaned and recoated as needed
- Screws are used for easy on-site dissassembly
- Various electrode coatings may be reapplied



Surface analysis

- TOPO and COMPO mix is done in the detector hardware
- 4Q signals are designed for topographic reconstruction
- Surface height/topography is measured when combined with scan controller for SEM (DISS6) and TOPO calibration sample

Hardware

Sensors	4x quadrant electrodes
	Carbon coated
	typ. 5 mm inner diameter
	typ. 25 mm outer diameter
	-10...10 V voltage bias
Preamplifiers	4x mounted in-situ
	Galvanic isolation
	$5x10^7$ V/A
	50 kHz bandwidth
Main amplifier (MICS-4)	4x independent signal channels
	-1.25 … 1.25 V (-50…50 mV with attenuator) input offset
	1× … 1,800× gain
	-1.25 … 1.25 V output offset
	3.4 MHz…34 Hz low-pass filter
	Automated 4Q global brightness and contrast
	Automated input offsets (dark correction)
	Automated gain normalization (bright correction)
	COMPO hardware mix signal (sum of BSE1...BSE4)
	TOPO hardware mixed signal (mix of BSE1...BSE4)
Mechanics (LIMA)	Port mounted, with vacuum bellows
	Motorized insertion/retraction motion
	-4...4 mm manual lateral and height alignment
	10 µm repositioning step size
	Integrated touch alarm, with automatic stop and retraction
	Passive cooling
Interfaces	1x USB 2.0 for amplifier control
	1x USB 2.0 for motion control
	1x RJ45 signal outputs
Signal outputs	Independent BSE1...BSE4
	COMPO (sum of BSE1...BSE4)
	TOPO (mix of BSE1...BSE4)

Software

Control	Detector drawing with selectable quadrants
	Bias, brightness and contrast controls
	Individual quadrants, or grouped COMPO/TOPO control
	Automatic go to inserted/retracted positions
	Fine repositioning/adjustments in mm units
In-situ automation	XML file format open/save settings
	JSON/RPC interface for remote control
	Automated brightness and contrast
Operating system	Windows 11 … Windows 7

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PC/Laptop, display (optional)

PC/Laptop	Intel Core i3 minimum
	2 × USB 2.0 minimum
Display	1,280 × 1,024 resolution minimum
	1 × display recommended
Operating system	Windows 11 … Windows 7
	Network connection recommended for remote support

Parts and cables

HT BSE detector	Standard 1×
Flange adaptor	Standard 1x
Power adaptor	Standard 1x
Signal cable	Standard 1×
USB control cables	Standard 2x
USB flash drive	Standard 1×
PC, keyboard, mouse	Optional 1×
Displays	Optional 1×

Software packages

Drivers	PEUSB
Libraries	MICSControl, LIMAControl
Software	Detector control app

Weight and dimensions

HT BSE detector arm	typ. 50 x 16 x 16 cm, typ 5.5 kg
HT BSE 4Q detector	typ. Ø40 mm, h: 5 mm
Flange adapter	depending on instrument
Power adapter	typ. 11 x 3 x 5 cm, typ 0.5 kg
Shipping	typ. 36 x 32 x 60 cm, typ 7 kg

Site requirements

Power	1× mains 108..253 VAC single phase 50/60 Hz
	On the same earth as the microscope
Microscope	1× to 4x video signal inputs on the SEM electronics
	Free BSE port on the SEM chamber
Space	Detector power adaptor may be placed on the floor

Our design principles

We look back on 30 years of experience in development and manufacture of high-performance instruments and technologies for microscopy.

We are driven by an ambition to expand abilities and to improve performance of electron microscopes.

Our aspiration is to make the best quality tools and to join our customers on their journeys of scientific exploration and discovery.

Performance
Microscopy must be a reliable and enjoyable experience
- Design for highest speed and resolution at the lowest noise
- Develop smart independent controllers for live optimization
- Support new users with simple and automated controls
- Assist advanced users with access to all parameters

Efficiency
Microscopes must provide an uninterrupted focus
- Use standard microscope controls and data formats
- Give instant feedback with live image mixing and processing
- Add bespoke software tools and algorithms for repetitive tasks
- Enable more developers with libraries and documentation

Environment
Products and technologies must be sustainable
- Reduce power consumption through smart design
- Minimize material use, embrace reuse where possible
- Save weight and volume for shipping and maintenance
- Enable everyone to develop sustainable innovations

Quantification
Data and control must be in physical units
- Calibrate, in production, for measured inputs and outputs
- Provide samples, procedures and software for calibration
- Give all control parameters in device independent values
- Ensure safe operation according to IEC61010-1 and IEC 61326-1

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