



EUROPEAN UNION
European Structural and Investing Funds
Operational Programme Research,
Development and Education



MINISTRY OF EDUCATION,
YOUTH AND SPORTS

PURCHASE CONTRACT

This purchase contract („**Contract**”) was concluded pursuant to section 2079 *et seq.* of the act no. 89/2012 Coll., Civil Code, as amended („**Civil Code**”), on the day, month and year stated below by and between:

- (1) **Institute of Physics of the Academy of Sciences of the Czech Republic, a public research institution,**

with its registered office at: Na Slovance 2, Praha 8, 182 21, Czech Republic

registration no.: 68378271

represented by: RNDr. Michael Prouza, Ph.D. – director

(„**Buyer**”); and

- (2) **TESCAN BRNO, s.r.o.**

with its registered office at: Libušina třída 816/1, 623 00 Brno - Kohoutovice

registration no.: 01733214

represented by: Ing. Petr Peřina

enrolled in the commercial register kept by Krajský soud v Brně, oddíl C, vložka 78909

(„**Seller**”).

(The Buyer and the Seller are hereinafter jointly referred to as „**Parties**” and individually as “**Party**”).

WHEREAS

- (A) The Buyer is a public contracting authority and the beneficiary of a grant of the Ministry of Education, Youth and Sports of the Czech Republic within the Operational Programme Research, Development and Education. The Buyer carries out a project financed by the grant specified herein in this provision („**Project**”).
- (B) For the successful realization of the Project it is necessary to purchase the Object of Purchase (as defined below) in accordance with the Rules for the Applicants and Recipients within the Operational Programme Research, Development and Education.
- (C) The Seller wishes to provide the Object of Purchase to the Buyer for consideration.



- (D) The Seller's bid for the public procurement entitled „**Scanning Electron Microscope (SEM) and its accessories**”, whose purpose was to procure the Object of Purchase („**Public Procurement**”), was selected by the Buyer as the most suitable.
- (E) The Seller acknowledges that the Buyer is not, in connection to the subject matter of this Contract, an entrepreneur, and also that the subject matter of this Contract is not related to any business activities of the Buyer.
- (F) The documentation necessary for the execution of the Contract is
- Technical Specification, which forms an integral part hereof as its Annex No. 1 (hereinafter the “TS”); this TS also formed a part of the procurement documentation for the Public Procurement in the form of Annex No. 1 of the procurement documentation;
 - The Seller's bid submitted for the Public Procurement (hereinafter the “Seller's bid”); the Seller's bid forms Annex No. 2 of this Contract

IT WAS AGREED AS FOLLOWS:

1. BASIC PROVISIONS

- 1.1 Under this Contract the Seller shall deliver and install to the Buyer a device as described and defined in Annex No. 1 (Technical Specification) and Annex No. 2 (Seller's bid) to this Contract in the required quality, and with the properties and related performance described therein („**Object of Purchase**”) and shall transfer to the Buyer ownership right to the Object of Purchase, and the Buyer shall take over the Object of Purchase and shall pay the Seller the Purchase Price (as defined below), all under the terms and conditions stipulated in this Contract.
- 1.2 Under this Contract the Seller shall also carry out the following activities („**Related Activities**”):
- a) Transport and delivery the Object of Purchase to the place of delivery (Art. 2.2 of the Contract);
 - b) Setup and installation of the Object of Purchase including direct measurements of respective parameters in line with Annex No. 1 - Technical Specification (“**Direct measurements**”) to be carried out at the end of installation at the place of delivery (Art. 2.2. of the Contract). Factory acceptance test carried out



by the Seller before the Object of Purchase is delivered to the place of delivery (Art. 2.2 of the Contract) cannot replace Direct measurements;

- c) Provide training related to the Object of Purchase. A timetable regarding delivery and training, approved by the Buyer must be provided before the Object of Purchase delivery, unless agreed otherwise between the Buyer and the Seller; and
- d) Cooperate with the Buyer during the performance of this Contract.

2. THE TIME AND PLACE OF DELIVERY

- 2.1 The Seller shall deliver the Object of Purchase and shall carry out Related Activities within **four (4) months** from the effectiveness of this Contract, unless stipulated otherwise in this Contract. The time of delivery is stipulated herein in favour of the Buyer. The Buyer is entitled to prolong the time for delivery Object of Purchase and for carrying out Related Activities for two (2) more months, should there be important reasons for that on the side of the Buyer, such as, but not only, impossibility to take over the Object of Purchase at the Buyer's premises due to reconstruction works taking place there.
- 2.2 The place of delivery shall be Fyzikální ústav AV ČR, v.v.i - HiLASE Centrum, Za Radnicí 828, 252 41 Dolní Břežany, Czech Republic or any other address in Dolní Břežany, Czech Republic, which the Buyer communicated to the Seller prior to the delivery of the Object of Purchase.
- 2.3 The Object of Purchase setup and installation under Art. 1.2.b.) of this Contract shall last for up to four working days following Object of Purchase delivery, unless Buyer and Seller agree otherwise. The training under Art. 1.2.c.) of this Contract shall be carried out for approximately five people/Buyer's employees, shall start on the last day of the Object of Purchase installation and shall take at least two working days in length, unless Buyer and Seller agree otherwise.
- 2.4 The Seller acknowledges that the deadlines stated in this Article are of essential importance to the Buyer with respect to the timeline of the Project with respect to the deadline by which the Project are to be implemented, and that the Buyer could incur damage as a result of failure to meet the above stipulated deadlines.



3. **THE OWNERSHIP RIGHT**

The ownership right to the Object of Purchase shall be transferred to the Buyer upon the signature of the Hand – over protocol (delivery note).

4. **PRICE AND PAYMENT TERMS**

- 4.1 The purchase price for the Object of Purchase is **9.980.000 CZK** („**Purchase Price**”) **excluding VAT**.
- 4.2 The Purchase Price cannot be exceeded and includes all costs and expenses of the Seller related to the performance of this Contract. The Purchase Price includes, among others, all expenses related to the delivery, handover of the Object of Purchase and execution of Related Activities, costs of copyright, insurance, customs, warranty service and any other costs and expenses connected with the performance of this Contract.
- 4.3 The Purchase Price for the Object of Purchase shall be paid on the basis of a tax document – invoice, to the account of the Seller designated in the invoice. The Purchase Price shall be paid only after the Hand – over protocol is signed.
- 4.4 The Buyer shall realize payments on the basis of duly issued invoice within thirty (30) calendar days from their receipt. If the Seller stipulates any shorter due period of the invoiced amount in the invoice, such different due period shall not be deemed relevant and the due period stipulated herein prevails. The invoice shall be issued only after the Hand – over protocol signature.
- 4.5 The invoice issued by the Seller as a tax document must contain all information required by the applicable laws of the Czech Republic. Invoices issued by the Seller in accordance with this Contract shall contain in particular following information:
 - a) Name and registered office of the Buyer,
 - b) Tax identification number of the Buyer,
 - c) Name and registered office of the Seller,
 - d) Tax identification number of the Seller,
 - e) Registration number of the tax document,
 - f) Scope of the performance under this Contract (including the reference to this Contract),
 - g) Date of the issue of the tax document,



- h) Date of the fulfilment of the Contract,
- i) Purchase Price,
- j) Registration number of this Contract, which the Buyer shall communicate to the Seller based on Seller's request before the issuance of the invoice,
- k) Declaration that the performance of the Contract is for the purposes of the Project; the exact details of the Project including name and reg. number will be communicated to the Seller based on Seller's request which shall be sent to the Buyer to following e-mails: [REDACTED] before an invoice is issued. Seller shall issue an electronic invoice and send it to following e-mails [REDACTED] for preliminary check. After the preliminary check the Seller shall send the final electronic invoice to efaktury@fzu.cz,

and must also comply with any double taxation treaties applicable to the given case.

- 4.6 The last invoice in each calendar year must be delivered by the Seller to the Buyer's no later than by December 15 of the given calendar year. In case that the invoice shall not contain the above mentioned information or the invoice does not comply with the requirements stipulated by law or the invoice is delivered to the Buyer later than by December 15 of the given calendar year, the Buyer is entitled to return it to the Seller during its maturity period and this shall not be considered as a default. The new maturity period shall begin from the receipt of the supplemented or corrected invoice to the Buyer.
- 4.7 The Buyer's invoicing details are set out in provision (1) hereof.

5. SELLER'S RIGHTS AND DUTIES

- 5.1 The Seller shall ensure that the Object of Purchase and Related Activities are in compliance with this Contract including all its annexes and applicable legal (e.g. safety), technical and quality norms.
- 5.2 During the performance of this Contract, the Seller proceeds independently. If the Seller receives instructions from the Buyer, the Seller shall follow such instructions unless these are against the law or in contradiction to this Contract. If the Seller, while exercising due professional care, finds out or should have found out that the instructions are for any reason inappropriate or illegal or in contradiction to this Contract, then the Seller must notify the Buyer.



5.3 All things necessary for the performance of this Contract shall be procured by the Seller, unless this Contract stipulates otherwise.

6. **HANDOVER OF THE OBJECT OF PURCHASE**

6.1 Handover and takeover of the Object of Purchase shall be realized on the basis of hand-over protocol (“**Hand – over protocol**”) which shall be signed during Object of Purchase setup and installation and which shall contain following information:

- identification of the Seller, the Buyer and all subcontractors, if there are any,
- description of the Object of Purchase,
- the list of defects and deficiencies of the Object of Purchase, if there are any, and the deadlines for their removal,
- the signature and the date of the hand-over.

6.2 Instructions and manuals related to all items of the Object of Purchase shall be attached to the Hand-over protocol at the latest.

6.3 If the Seller fails to duly carry out all Related Activities or if the Object of Purchase does not fully meet requirements of this Contract, the Buyer is entitled to refuse the takeover of the Object of Purchase. In such a case, the Seller shall remedy the deficiencies within thirty (30) calendar days, unless Parties agree otherwise. The Buyer is entitled (but not obliged) take over the Object of Purchase despite the above mentioned deficiencies, in particular if such deficiencies do not prevent the Buyer in the proper operation of the Object of Purchase. In such a case, the Seller and the Buyer shall list the deficiencies in the Hand-over protocol, including the manner and the date of their removal (remedy). If the Parties do not reach agreement in the Hand-over protocol regarding the date of the removal, the Seller shall remove the deficiencies within fourteen (14) calendar days.

6.4 Parties hereby exclude application of section 2126 of the Civil Code.

7. **WARRANTY**

7.1 The Seller hereby provides a warranty of quality of the Object of Purchase for the period of **36 months**.



- 7.2 The warranty period shall commence on the day of the signature of the Hand-over protocol by both Parties. However, if the Object of Purchase is taken over with defects or deficiencies, the warranty period shall commence on the date of the removal of the last defect or deficiency by the Seller.
- 7.3 The Seller shall remove defects that occur during the warranty period free of charge.
- 7.4 If the Buyer ascertains a defect of the Object of Purchase during the warranty period, the Buyer shall notify such defect without undue delay to the Seller (“**Warranty Claim**”). Defects may be notified on the last day of warranty period, at the latest; an e-mail is considered an adequate way to initiate a Warranty Claim. Warranty Claim sent by the Buyer on the last day of the warranty period shall be deemed to be made in time.
- 7.5 The Buyer notifies defects in writing via e-mail. The Seller shall accept notifications of defects on the following e-mail address: TESCAN service support portal
- 7.6 In the Warranty Claim the Buyer shall describe the defect and the manner of removal of the defect. The Parties shall agree on the manner of defect’s/defects’ removal. If the Parties do not reach the agreement, the Buyer has the right to:
- a) request removal of the defect/defects by the delivery of Object of Purchase or its individual parts, or
 - b) request removal of the defect/defects by repair, or
 - c) request adequate discount from the Purchase Price.

The choice among the above mentioned rights shall be made by the Buyer. However, in case of a removable defect/defects that occur/occurs for the first time the Buyer shall not request removal of the defect by delivery of new Object of Purchase or its individual parts.

- 7.7 The Seller shall remove the defect within fourteen (14) calendar days from the date on which the Warranty Claim was notified to the Seller, at the latest, unless the Buyer and the Seller agree otherwise.
- 7.8 The Seller shall remove defect/defects of the Object of Purchase within periods stated in the Contract also in the instances when the Seller is of the opinion that he is not liable for such defects. In cases when the Seller will not recognize the defect and the Buyer will not agree with such conclusion, the validity of the Warranty Claim shall be ascertained by an expert, which is to



be commissioned by the Buyer but with whom the Supplier also must agree. In the event the expert declares the Warranty Claim as justified, the Seller shall bear the costs of the expert's assessment. If the Warranty Claim is raised unjustly according to expert's assessment, the Buyer shall reimburse the Seller all reasonably incurred costs associated with removing the defect/defects.

- 7.9 Parties shall execute a protocol on the removal of the defect, which shall contain the description of the defect/defects and the confirmation that the defect/defects was/were removed. The warranty period shall be extended by the time that expires from the date of exercising the Warranty Claim until the defect/defects is/are removed in cases where the Buyer was prevented from using the Object of Purchase for its intended purpose.
- 7.10 In case that the Seller fails to remove the defect/defects within time stipulated in this Contract or if the Seller refuses to remove the defect/defects, then the Buyer is entitled to remove the defect/defects at his own costs and the Seller shall reimburse these costs within thirty (30) calendar days after the Buyer's request to do so.
- 7.11 The warranty does not cover defects caused by unprofessional handling or by the failure to follow Seller's instructions for the operation and maintenance of the Object of Purchase.
- 7.12 Parties exclude application of the section 1925 (the sentence behind semi-colon) of the Civil Code.
- 7.13 The Seller shall provide to the Buyer technical support (consultation of operational, maintenance and other issues regarding the Object of Purchase) free of charge on the phone no.: TESCAN service support portal

8. **TERMINATION, RIGHT OF WITHDRAWAL, CONTRACTUAL PENALTIES**

- 8.1 This Contract may be terminated by completing the performance required hereunder, by agreement of the Parties or by withdrawal from the Contract on the grounds stipulated by law or in the Contract.
- 8.2 The Buyer is entitled to withdraw from this Contract, if any of the following circumstances occur:
- (a) the Seller has materially breached obligations imposed by the Contract, specifically by being in delay with the fulfilment of this Contract and such delay lasts more than 4 weeks; or



- (b) the Seller has materially breached obligations imposed by the Contract, specifically Object of Purchase fails to meet technical parameters and qualities or other requirements defined in the Annex No. 1 (Technical Specification) and those technical parameters and qualities or other requirements defined in Annex No. 2 (Seller's Bid), which were evaluated within Public Procurement under Suitability and Quality Performance evaluation sub-criterion ;
 - (c) the insolvency proceeding is initiated against the Seller's assets;
 - (d) the funding body providing finances for the Project ("Financial subsidy") or any other control body determines that the expenditures or part of the expenditures incurred on the basis of this Contract are ineligible;
 - (e) the Financial subsidy for implementation of the Project is withdrawn from the Buyer; or
 - (f) should it become apparent that the Seller provided information or documents in the Seller's bid, which were not true and which could, therefore, influence the outcome of the Procurement Procedure leading to the conclusion of this Contract (Section 223(2)(b) of the Act No. 134/2016 Coll., on public procurement).
- 8.3 The Seller is entitled to withdraw from the Contract in the event of material breach of the Contract by the Buyer and in case of events outside the control of the Seller (e.g. natural disasters, etc.).
- 8.4 In the event the Seller is in delay with term of delivery as stipulated in Art. 2 herein, the Seller shall pay to the Buyer the contractual penalty in the amount of 0.1% of the Purchase Price for each, even commenced calendar day of delay.
- 8.5 In the case where the Seller fails to remove defects within the periods stipulated in the Contract, the Seller shall pay to the Buyer a contractual penalty in the amount of 2.500 CZK for each defect and for each calendar day of delay.
- 8.6 If the Buyer fails to pay the Purchase Price vices within the deadlines set out in this Contract, the Buyer shall pay the Seller interest on delay in the amount set forth by the law for each day of delay unless the Buyer proves that the delay with the payment of the Purchase Price was caused by late release of the Financial subsidy for the Project by the funding body.



- 8.7 The obliged Party must pay any contractual penalty/penalties to the entitled Party not later than within fifteen (15) calendar days of the date of receipt of the relevant claim from the other party.
- 8.8 Payment of the contractual penalties pursuant to this Article shall in no way prejudice the Buyer's right to claim compensation for damage incurred by the Buyer as a result of the Seller's breach of obligations to which the penalty applies.
- 8.9 The Parties have agreed that the maximal amount of contractual penalties shall be limited to 10% of the Purchase Price.
- 8.10 The Buyer is entitled to set off by unilateral declaration any of its receivable or part of its receivable resulting from contractual penalty/contractual penalties against Seller's claim to pay Purchase Price.

9. **SPECIAL PROVISIONS**

By signing this Contract, the Seller becomes a person that must cooperate during the finance control within the Act no. 320/2001 Coll., on finance control in the public administration, as amended, and shall provide to the Directing Body of the Operational Programme Research, Development and Education or other control bodies (such as, but not only, European Commission, European Court of Auditors) access to all parts of the bid, Contract or other documents that are related to the legal relationship formed by this Contract. This duty also covers documents that are subject to the protection in accordance with other acts (business secrets, secret information, etc.) provided that control bodies fulfil requirements stipulated by these acts. The Seller shall secure that all its subcontractors are also obliged to cooperate with control bodies in the above stipulated extent. The Seller shall secure that all its subcontractors are also obliged to cooperate with control bodies in the above stipulated extent. The Seller is obliged to duly archive all written material prepared in connection with the execution of this Contract and to provide access to the Buyer to these archived documents until 2027; any finance control may also be carried out until year 2027.

10. **FINAL PROVISIONS**

- 10.1 This Contract is governed by the laws of the Czech Republic, especially by the Civil Code.
- 10.2 All disputes arising out of this Contract or out of legal relations connected with this Contract shall be preferable settled by a mutual negotiation. In case that the dispute is not settled within sixty (60) calendar days, such dispute shall be decided by courts of the Czech Republic in the procedure initiated by one of the Parties.



- 10.3 All modifications and supplements of this Contract must be carried out in writing as numbered amendment/amendments.
- 10.4 In the event that any of the provisions of this contract shall later be shown or determined to be invalid, putative, ineffective or unenforceable, then such invalidity, putativeness, ineffectiveness or unenforceability shall not cause invalidity, putativeness, ineffectiveness or unenforceability of the Contract as a whole. In such event the Parties undertake without undue delay to subsequently clarify any such provision using Sec 553(2) of the Civil Code, or to replace after mutual agreement such invalid, putative, ineffective or unenforceable provision of the Contract by a new provision, that in the extent permitted by the laws and regulations of the Czech Republic, relates as closely as possible to the intentions of the Parties to the Contract at the time of creation hereof.
- 10.5 The Parties agree that the Seller shall not be entitled to set off any part of its receivable, or receivable of its sub-debtor against the Buyer or any of his receivables, unless this Contract stipulates otherwise. The Seller shall not be entitled to assign any receivable arising in connection herewith to a third party. The Seller shall not be entitled to assign any rights or obligations arising to him hereunder or any of its parts to third parties.
- 10.6 The Parties declare that they accept the “risk of changed circumstances” within the meaning of Sec 1765(2) of the Civil Code.
- 10.7 The Parties declare that they shall maintain confidentiality with respect to all facts and information they learned in connection with the Contract or during the performance of the Contract, and the disclosure of such facts or information could cause damage to the other Party. This confidentiality provision does not affect duties of Parties with respect to applicable legislation.
- 10.8 This Contract shall constitute complete agreement of the Parties on the Contract subject matter including the Object of Purchase and shall substitute any and all possible previous discussions, negotiations and agreements of the Parties related to the Contract subject matter including the Object of Purchase.
- 10.9 The following Annexes form an integral part of the Contract:
- **Annex No. 1:** Technical Specification Document (if Annex No. 1 uses the term “Contracting Authority” or “contracting authority” it means Buyer. If Annex No. 1 uses the term “Supplier” or “supplier”, it means Seller);



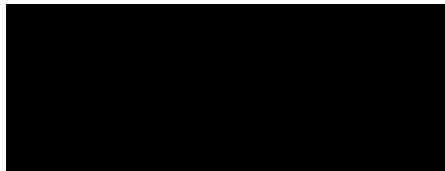
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MINISTRY OF EDUCATION,
YOUTH AND SPORTS

IN WITNESS WHEREOF Parties attach their signatures:

Buyer



Signature:

Name: RNDr. Michael Prouza, Ph.D.

Position: director

Date:

Seller



Signature:

Name:

Ing. Petr Peřina

Position:

Managing Director

Date:



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ANNEX NO. 1
TECHNICAL SPECIFICATION

Annex No. 1 – Technical specification

The required device is an instrument that allows imaging and analysis of samples by using focused electron beam as a mean for generation of signals from the observed sample that are then detected and processed into the comprehensive form by the device. SEM must be equipped with field emission based electron source and at minimum with detectors of secondary electrons, back-scattered electrons, transmitted electrons and Energy Dispersive Spectroscopy (EDS) detectors for X-ray analysis. Means for high resolution imaging at low accelerating voltages must be available. SEM will be used for sample observations and chemical analysis of micro and nanostructures.

Scanning Electron Microscope and all its accessories are required to fulfill specifications in this document. Namely:

- Scanning Electron Microscope with detectors and accessories defined by the requirements, electronics, PC and backup power supply.
- Vacuum system customized according to laboratory layout.
- System for AC and DC magnetic field shielding.
- Active system for damping external mechanical vibrations.
- Sputter coater for noble metal coatings.
- Installation of device and all its parts.
- On-site training.
- Warranty and service.

The device must be delivered by supplier with all accessories necessary to comply with technical specifications and requirements set in this document and must be installed and put into operation by supplier. The required technical parameters are listed in in Tables 1-8. Price must contain service and warranty for exactly specified time.

Vacuum pumps, backup power unit and other supporting accessories that do not need to be in the same room as the microscope will be kept in nearby technical room. Room layout is in Fig. 1. Supplier must respect this in proposed solution.

Table 1: **Technical features of the SEM**

<i>Technical/functional feature</i>	<i>Required parameter/value</i>	<i>Explanation of parameters</i>
Electron source	High-brightness Schottky emitter	
Accelerating voltage	Adjustable in the range 200 eV – 30 keV (down to 50 eV in low accelerating voltage regime)	For fast and easy adjustment of optimal conditions needed for different types of samples

Primary beam current on the sample	Minimum available range: 6 pA – 100 nA	
pA meter	YES	Probe current measurements
Magnification	2x – 1,000,000x with non-distorted picture	For easy orientation on the sample surface as well as for large magnification and observation of micrometer or nanometer sized objects
Beam stability	Variation of beam current at the sample better than 2% per 24 hours.	
Scanning speed of primary electron beam	From 30 ns to 1.5 ms per pixel	For wide range of samples and ability to protect potential sensitive sample surfaces from damage
Chamber	At least 230 mm in diameter or larger with minimum 11 ports to add detectors or relocate them.	
Chamber and columns suspension	System and/or means for isolation of external mechanical vibrations. Means of isolation of both high and low frequencies must be provided	
Chamber view camera	Integrated IR TV camera	Needed for live inner view of chamber parts
Vacuum system	Operation in high vacuum mode	
	Oil-free turbo pump and dry forevacuum pump	
	Chamber vacuum < 10^{-2} Pa	
	Gun vacuum < 3×10^{-7} Pa	
	Pumping time < 5 minutes	
Detectors	Minimum one detector of secondary electrons (SE)	SE detector of Thornley type (monocrystal scintillator) for observing sample surface
	Minimum one detector of secondary electrons located in the column	Intended for high resolution especially at short working distances
	Minimum one back-scattered electrons (BSE) detector for low energies	Material contrast imaging by detection of low-angle back-scattered electrons

	Minimum one back-scattered electrons detector located in column	Intended for high resolution of material contrast at short working distances
	Detector of transmitted electrons	Scanning transmission electron microscope detector with bright field (BF), dark field (DF) and high angle dark field (HADF) segments, ability to capture color images.
Technology of negative potential applied to the stage in order to improve the resolution at low accelerating voltages	Resolution better than 1.8 nm @ 1 kV, observation of magnetic samples	Intended for the highest resolution at low beam voltages
Resolution	Better than 1.5 nm @ 15 kV (SE)	After use of the proposed magnetic field shielding solution
	Better than 2.5 nm @ 3 kV (SE)	
	Better than 4.5 nm @ 1kV (SE).	
	Better than 0.8 nm @ 30 kV (transmitted electrons)	
Plasma cleaner for SEM chamber	YES	To prevent contamination artefacts in SEM images
Other features	Protocol to send commands to the microscope electronics in form of an external script via the provided PC	
	Control panel	For manual control of SEM functions
	Uninterruptible power supply, min. 2 kW	

Table 2: **Sample stage**

Stage specifications	Fully motorized and computer controlled.
	Five axes – X, Y, Z, rotation, tilt.
	Stage must have graphical representation in SW with easy user navigation between samples.
	Possibility to measure current of primary beam on stage.
	Auto-calibration procedure.

	Protection against crashing into objective or detectors. Movement must be stopped when sample touches any part of the chamber.
X range	80 mm (+40 mm to -40 mm) or more
X, Y range	60 mm (+30 mm to -30 mm) or more
X, Y repeatability	Better or equal to 2 μm when returning from maximum distance allowed by axis.
Z range	45 mm or more.
Rotation	360 degrees, continuous.
Tilt	At least 100 degrees total range, where minimum 10° tilt with respect to the horizontal position is available in both directions.
Max load	Stage operable for loads up to 1 kg (assuming tilt = 0°).

Table 3: **Double EDS analytical system**

Both EDS detectors integrated within one SEM chamber.	
Reduced SEM working distance (10 mm or less) for both EDS detectors for better sensitivity.	
Both EDS detectors based on silicon drift technology (SDD EDS detectors), LN2 free, vibration free with integrated Peltier cooling. Motorised slide into operation position and retraction for both EDS detectors included.	
EDS detector 1	EDS detector optimized for analysis of nanoparticles, nanolayers and multilayers at very low accelerating voltages.
	Windowless SDD EDS detector operation for maximum sensitivity at low energy range at least 0 - 5 keV.
	Minimum required active area size for EDS detection sensor $\geq 100 \text{ mm}^2$.
	At least 0.2 srad collection space angle (solid angle).
	Integrated, protective EDS detector flap required.
	Integrated pressure sensor for protection of EDS detector from accidental loss of chamber pressure.
	Required detection, qualitative and quantitative analysis of elements in range from Li to Bi.
	Guaranteed energy resolution $\leq 127 \text{ eV}$ for manganese (Mn, K alpha line), measured in compliance with ISO 15632:2012 (at least 100 000 cps, output count rate) and confirmed by direct measurement after installation onsite.
	Guaranteed energy resolution $\leq 56 \text{ eV}$ for carbon (C, K alpha line), measured in compliance with ISO 15632:2012 (at least 100 000 cps, output count rate) and confirmed by direct measurement after installation onsite.

	Must be able to resolve and perform EDS analysis on nanoparticles starting from size of 10 nm in diameter. Confirmation by direct measurement based on elemental distribution maps (Au dots standard) required after installation.
	Must be able to analyze signal from thin layer of a typical thickness of a few tens of nanometers or multilayers without collecting signal from underlying material.
EDS detector 2	EDS detector optimized for qualitative and quantitative analysis within broad accelerating voltage range (0-30 kV).
	Minimum required active area size for EDS detection sensor $\geq 100 \text{ mm}^2$.
	Required detection, qualitative and quantitative analysis of elements in range from Be to Cf.
	Guaranteed energy resolution $\leq 127 \text{ eV}$ for manganese (Mn, K alpha line), measured in compliance with ISO 15632:2012 (at least 100 000 cps, output count rate) and confirmed by direct measurement after installation onsite.
	Guaranteed energy resolution $\leq 56 \text{ eV}$ for carbon (C, K alpha line), measured in compliance with ISO 15632:2012 (at least 100 000 cps, output count rate) and confirmed by direct measurement after installation onsite.
Software	Compatible with Win 10.
	Multiuser analytical system.
	The complete integration of both EDS detectors and their full control and ensuring functionality within one software interface is required. The software must provide intuitive and easy access to all detector functions, monitor and inform user about state of the individual detectors, control SEM stage.
	Data transfer between all parts of the software must be done without user action.
	Integrated live (TV mode), simultaneous acquisition of SE image, BSE image, elemental distribution maps and live peak labelled spectrum acquisition in real time within one software interface.
	Automated record of locations visited on the sample along with what elements have been detected.
	SW must contain libraries for identification of individual peaks and provide automatic peak labeling during spectrum acquisition without the need for user action.
	Quantitative standardless analysis included. Possibility of quantitative analysis with use of standards, work with fully editable standardization libraries.
	Quantitative analysis (standardless and with use of standards) guaranteed for full required energy range 0 – 30 keV.
	Spectra import and export in open format (EMSA).

	Point analysis, line analysis, rectangle area analysis and freehand area quantitative analysis.
	Elemental distribution mapping (in range Be-Cf) includes also quantitative elemental distribution mapping. Minimum required resolution for all elemental distribution maps $\geq 8000 \times 8000$ points.
	Elemental linescanning includes also quantitative elemental linescanning. Minimum required resolution for all linescans ≥ 8000 points.
	Phase detection, phase analysis, analysis of chemical composition of phases, modal analysis.
	Full and automated SEM stage operation (x, y, z axes at least) from EDS software.
	Reactive and predictive drift correction included. Use of both corrective methods simultaneously.
	Integrated solution for resolution of spectral peaks overlaps based on deconvolution methods, pulse pile-up correction for all pulse pile-ups peaks of 1 st -3 rd order as minimum during data acquisition for all qualitative and quantitative data includes also elemental distribution maps and linescans.
	At least one off line license for all supplied analytical software.
	All supplied software update for at least 5 years free of charge.

Table 4: **Computer**

Hardware	64-bit computer with processor, graphic card and RAM having sufficient performance to run smoothly the software(s) provided for SEM and EDS control and for image acquisition and analysis.
	At least two hard drives of capacity 250 GB each. At least one of them must be SSD
	At least 16 GB RAM.
	Provided with appropriate Operational System and software for operating the SEM as specified here in the tables, so compatible with Windows 10
	Dual full HD monitors of size 24 inch or larger.
	Mouse, keyboard, trackball (or other device for easy control of microscope software).

Table 5: **Microscope control software, imaging and image processing tools**

Software compatibility	Compatible with Windows 10
Software characteristics	Software must integrate controls for main microscope functionalities in one application, provide intuitive and easy access to all microscope

	functions, monitor and inform user about state of the individual subsystems, displace, rotate and tilt the sample stages, protect sensitive parts of microscope from operation under dangerous conditions.
Remote access	Remote access to the SEM must be allowed.
Updates and support	Support and maintenance for the software must be available and updates regularly provided
Other software features	Must support multiuser mode.
	Must provide diagnostic function of the entire system.
	Focusing window inside scanning window.
	Dynamic focus for non-flat surfaces.
	Measurement of distances and dimensions in the image with precision better than 3%.
	Saving images in common formats (at least TIFF, BMP, JPG and GIF).
	Possibility to save images in high resolution, at least 16384 x 16384 px.

Table 6: **Sputter coater**

Vacuum	Operating with vacuum level corresponding to residual pressure of 2×10^{-2} mbar or less
	Vacuum components necessary for operation must be part of delivery and installed by supplier.
Sample coating	Au, Ag and Pt sputtering targets.
	Automatic sputtering procedure.
	Possibility to predefine and store sputtering conditions by user.
	Chamber diameter at least 120 mm in diameter and 100 mm in height.
	Metal film thickness monitor included

Table 7: **Magnetic field shielding system**

Magnetic field shielding type	Active shielding to compensate external magnetic field in the region of the SEM column and chamber. Field components measured by at least one provided sensor. The solid frames holding the wiring meant to produce the cancellation fields must be supplied and their construction adapted to ensure sufficient field cancellation inside the shielded space.
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Bandwidth of the shielded field	DC – 5 kHz
Minimal dynamic range	4.8 μ T pk-pk
Field cancelling factor	100 or higher at 50/60 Hz
	400 or higher at DC

Table 8: **Accessories**

Calibration standards	High contrast sample for measurement of resolution.
	Calibration standard samples for EDS composition analysis.
Accessories for microscope operator	Dust-free gloves.
	Stainless steel tweezers.
	Conducting tape compatible with vacuum environment
	Non-conducting tape compatible with vacuum environment.
	Stubs for attaching samples, compatible with stage carousel, and plastic boxes for stubs storage and transportation.
	Special sample holders. At least tilted and higher holder.
	Box with tools necessary for microscope parts maintenance containing at least screw drivers, dust-free wipers, IPA or other chemical for cleaning of vacuum parts.

Table 9: **Conditions of delivery, warranty and service**

Delivery	All parts that are subject of this tender must be delivered no later than 6 months from the date of the order. <i>(See related section of bidders invitation).</i>
Warranty must include	Warranty for at least 24 months for all parts of microscope including vacuum system, active vibration isolation, AC+DC field cancelation system, sputter coater and EDS system.
Service	Service response no later than three days from written report including service and support for third party components (EDS, AC+DC field cancelation, vibration isolation system ...).
Replacement of parts with limited lifetime	Similar parts must be available to replace at least five years after the date the microscope has been purchased. This means that replacement will not cause to downgrading of these specifications.



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MINISTRY OF EDUCATION,
YOUTH AND SPORTS

ANNEX NO. 2
SELLER'S BID

**Public tender:
Scanning Electron Microscope (SEM) and its accessories**

ORIGINAL OF THE QUOTATION

Submitter: Fyzikální ústav akademie věd České republiky

Seat: Na Slovance 2, 182 21 Praha 8

IČ: 683 78 271

DIČ: CZ68378271

Contender: TESCAN Brno, s.r.o.

Seat: Libušina tř. 816/1, 623 00 Brno

IČ: 01733214

DIČ: CZ01733214

Cover Bid Note

Public Contract Name:

„ Scanning Electron Microscope (SEM) and its accessories”

Contracting authority	Institute of Physics of the Czech Academy of Sciences, public research institution
Registered Office:	Na Slovance 2,182 21 Prague 8, Czech Republic
Company Identification No.:	683 78 271
Tax Identification No.:	CZ68378271
Person authorised to act on behalf of the Contracting authority:	RNDr. Michael Prouza, Ph.D., Director

Economic operator Business Name incl. Legal Form: **TESCAN Brno, s.r.o.**

Registered Office:

Libušina tř. 816/1, Brno-Kohoutovice, 62300

Company Identification No.:

01733214

Tax Id. No.:

CZ01733214

Small / Medium-sized enterprises
(in accordance with the
Recommendation 2003/361/ES):

NO

Bank:

Citibank Europe plc., Bucharova 2641/14,

Person authorized
to represent the participant:

Contact person:

Contact address:

Tel:

E-mail of the Contact Person:

Data relevant for evaluation:

Total Bid Price in CZK net of VAT:

9.980.000 CZK

Total Bid Price in CZK including VAT:

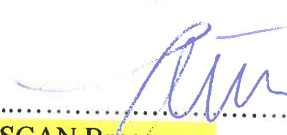
12.075.800 CZK

(stating a bid price in CZK including VAT is not applicable for foreign bidders)

Warranty length (in calendar months)

36

In Brno On 15.7.2019


.....
TESCAN Brno, s.r.o.
Petr Peřina, jednatel

TESCAN Brno, s.r.o.
Libušina tř.1, 623 00 Brno, CZ
DIČ: CZ01733214 

Affirmation on Qualification Criteria

*pursuant to the Sec 86 (2) of the Act No. 134/2016 Coll., on Public Procurement, as amended
(hereinafter the "Act")*

Public Contract Name:

„ Scanning Electron Microscope (SEM) and its accessories”

Economic operator Business Name incl. Legal Form: TESCOAN Brno, s.r.o.

Registered Office: Libušina tř. 816/1, Brno-Kohoutovice, 62300

Company Identification No.: 01733214

Authorized Representative: 

1. Basic Criteria

The Economic operator hereby solemnly declares that it:

- a) was not convicted by final judgement in the country of its registered seat of a crime specified in Annex No. 3 to the Act or another similar crime pursuant to the law of the country of its registered office in the in the past five years preceding the commencement of the procurement procedure; expunged convictions are disregarded,
- b) has not outstanding tax arrears registered in tax records in the Czech Republic or in the country of its registered office,
- c) has not outstanding arrears in respect of payments and penalties of public health insurance in the Czech Republic or in the country of its registered office,
- d) has not outstanding arrears in respect of payments and penalties of social security contributions and contribution to the national employment policy in the Czech Republic or in the country of its registered office,
- e) is not in liquidation, has been declared insolvent, in respect of whom the receivership has been imposed under another legal regulation or is in a similar situation pursuant to the law of the country of its registered office.

2. Professional Criteria

The Economic operator hereby solemnly declare that it fulfils the professional criteria stipulated by the Contracting authority within the Public Contract pursuant to Section 77(1) of the Act.

3. Technical Qualification Criteria

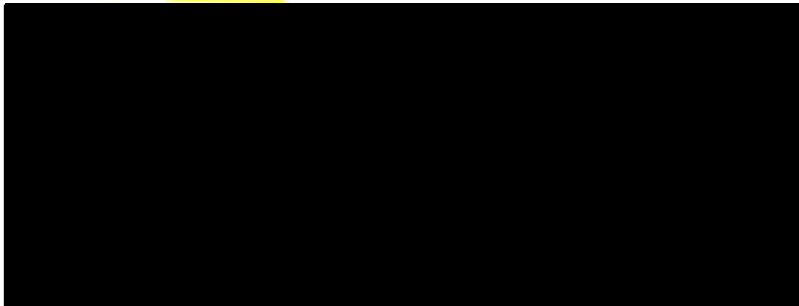
The economic operator hereby solemnly declare that it fulfils the technical qualification criteria stipulated by the Contracting authority within the Public Contract pursuant to Sec 79 (2) (b) of the Act,

List of the Important Supplies:

Identification of Client (Name and Registered Seat)	Dates of Provision (using months and years)	Price	Description of Significant Supply	Contact Persons of Clients (Names) and Contact Data (Email/Phone)
Policie České republiky Kriminalistický ústav	May 2017	[REDACTED]	SEM MIRA XMU + EDX X-Max 80	[REDACTED]

since we have realized the above mentioned supplies within the last three years.

In Brno On 15.7.2019





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Affirmation on Suitability and Quality Performance Evaluation Criteria

*pursuant to the Sec 86(2) of the Act No. 134/2016 Coll., on Public Procurement, as amended
(hereinafter the "Act")*

Public Contract Name:

„Scanning Electron Microscope (SEM) and its accessories”

Economic operator Business Name incl. Legal Form: TESCAN Brno, s.r.o.

Registered Office: Libušina třída 816/1

Company Identification No.: 01733214

Authorized Representative: Petr Peřina

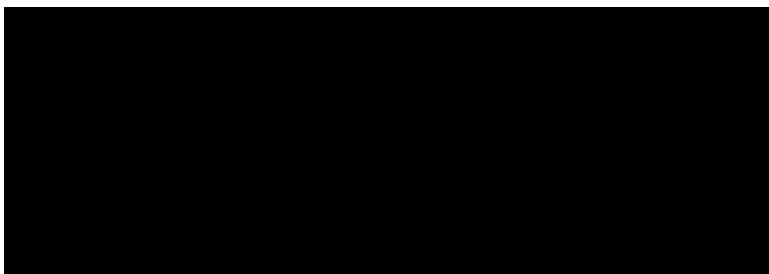
Pursuant the article no. 5 of the Procurement Documentation the economic operator declares following criteria of suitability and quality:

1. Maximum scanning speed of primary e-beam:	20ns – 10ms per pixel
2. Stage type:	compucentric
3. Tilt range of the stage:	-80° to +80°
4. Precision of the dimension measurement in the image (difference between dimension of a calibrated sample and dimension measured in the SEM):	magnification accuracy below 2,99%
5. All supplied EDS software update free of charge:	Yes, 10 years



6. Automate EDS analysis functions include multiple image, multiple elemental distribution map acquisition and multiple field analysis. Stitching of collected image and map data into one data file. Automated multiple field EDS data acquisition without the need for user intervention.	Yes
7. Integrated, protective flap for windowless EDS detector:	Yes

Source Parameters:



Petr Peřina, jednatel

Technical specification of Scanning Electron Microscope (SEM) and its accessories

Table 1: Technical features of the SEM

<i>Technical/functional feature</i>	<i>MIRA3 LMH technical specification</i>
Electron source	High-brightness Schottky emitter
Accelerating voltage	Adjustable in the range 200 eV – 30 keV (down to 50 eV in low accelerating voltage regime)
Primary beam current on the sample	2 pA – 200 nA
pA meter	YES
Magnification	2x – 1,000,000x with non-distorted picture
Beam stability	Beam current stability at the sample better than 2% per 24 hours.
Scanning speed of primary electron beam	From 20 ns to 10 ms per pixel
Chamber	230 mm in diameter, 11+ ports to add detectors or relocate them.
Chamber and columns suspension	Fully integrated active vibration isolation system
Chamber view camera	Integrated IR TV camera
Vacuum system	Operation in high vacuum mode
	Oil-free turbo pump and dry forevacuum pump
	Chamber vacuum < 9×10^{-3} Pa
	Gun vacuum < 3×10^{-7} Pa
	Pumping time < 3 minutes
Detectors	Detector of secondary electrons (SE), In Beam, Detector of secondary electrons located in the objective and intended for high resolution and short working distances
	Detector of secondary electrons (SE) located in the column, Everhart-Thornley type (monocrystal scintillator)
	Back-scattered electrons detector for low energies (LE-BSE), retractable, annular back-scattered electron detector (scintillator type) for low energy imaging down to 200 eV
	Back-scattered electrons detector located in column
	Detector of transmitted electrons, HADF R-STEM, retractable version of STEM detector for simultaneous acquisition of the Bright Field (BF), Dark Field (DF) and High Angle Dark Field (HADF) signals
Technology of negative potential applied to the stage in order to improve the resolution at low accelerating voltages	Resolution 1,8 nm @ 1 kV, observation of magnetic samples Beam Deceleration Technology (BDT) option Intended for the highest resolution at low beam voltages includes system for negative voltage biasing of the sample stage and in-beam detector that works either as SE detector (in BD mode) or BSE detector
Resolution	1,5 nm @ 15 kV (SE)
	2.5 nm @ 3 kV (SE)
	4.5 nm @ 1kV (SE).
	0.8 nm @ 30 kV (STEM detector)

Plasma cleaner for SEM chamber	Decontaminator
Other features	SharkSEM - Protocol to send commands to the microscope electronics in form of an external script via the provided PC
	Control panel
	Uninterruptible power supply, min. 2 kW

Table 2: **Sample stage**

Stage specifications	Fully motorized and computer controlled.
	Five axes – X, Y, Z, rotation, tilt.
	Stage graphical represent in SW with easy user navigation between samples.
	pA meter, Probe Current Measurements
	Stage calibration procedure
	Touch Alarm, Stops movements when sample touches any part of the chamber
X range	80 mm (-40 mm to +40 mm)
X, Y range	60 mm (-30 mm to +30 mm)
X, Y repeatability	Stage repeatability < 2 um when moving the stage to maximum value or minimum value is guaranteed.
Z range	47 mm
Rotation	360° continuous
Tilt	-80° to +80° from horizontal position
Max load	Stage operable for loads up to 1 kg (assuming tilt = 0°)

Table 3: **Double EDS analytical system**

Both EDS detectors integrated within one SEM chamber.	
Reduced SEM working distance (less than 10 mm) for both EDS detectors for better sensitivity.	
Both EDS detectors based on silicon drift technology (SDD EDS detectors), LN2 free, vibration free with integrated Peltier cooling. Motorised slide into operation position and retraction for both EDS detectors included.	
EDS detector 1 Ultim Max Extreme	EDS detector optimized for analysis of nanoparticles, nanolayers and multilayers at very low accelerating voltages.
	Windowless SDD EDS detector operation for maximum sensitivity at low energy range at least 0 - 5 keV.
	Active area size for EDS detection sensor 100 mm ² .
	Collection space angle (solid angle) 0.2 srad .
	Integrated, protective EDS detector flap.
	Integrated pressure sensor for protection of EDS detector from accidental loss of chamber pressure included.
	Detection, qualitative and quantitative analysis of elements in range from Li to Bi.
	Guaranteed energy resolution ≤ 127 eV for manganese (Mn K α line), measured in compliance with ISO 15632:2012 (at least 100 000 cps, output count rate), confirmation by direct measurement after installation onsite.

	Guaranteed energy resolution ≤ 56 eV for carbon (C K α line), measured in compliance with ISO 15632:2012 (at least 100 000 cps, output count rate), confirmation by direct measurement after installation onsite.
	EDS analysis of nanoparticles starting from size of 10 nm in diameter. Confirmation by direct measurement based on elemental distribution maps (Au dots standard) after installation.
	Analysis of signal from thin layer of a typical thickness of a few tens of nanometers or multilayers without collecting signal from underlying material.
EDS detector 2 Ultim Max 100	EDS detector optimized for qualitative and quantitative analysis within broad accelerating voltage range (0-30 kV).
	Active area size for EDS detection sensor 100 mm ² .
	Detection, qualitative and quantitative analysis of elements in range from Be to Cf.
	Guaranteed energy resolution ≤ 127 eV for manganese (Mn K α line), measured in compliance with ISO 15632:2012 (at least 100 000 cps, output count rate), confirmation by direct measurement after installation onsite.
	Guaranteed energy resolution ≤ 56 eV for carbon (C K α line), measured in compliance with ISO 15632:2012 (at least 100 000 cps, output count rate), confirmation by direct measurement after installation onsite.
Software Aztec Live	Compatible with Win 10.
	Multiuser analytical system.
	The complete integration of both EDS detectors and their full control and ensuring functionality within one software interface is required. The software provide intuitive and easy access to all detector functions, monitor and inform user about state of the individual detectors, control SEM stage.
	Data transfer between all parts of the software done without user action.
	Integrated live (TV mode), simultaneous acquisition of SE image, BSE image, elemental distribution maps and live peak labelled spectrum acquisition in real time within one software interface.
	Automated record of locations visited on the sample along with what elements have been detected.
	SW contain libraries for identification of individual peaks and provide automatic peak labeling during spectrum acquisition without the need for user action.
	Quantitative standardless analysis included. Possibility of quantitative analysis with use of standards, work with fully editable standardization libraries.
	Quantitative analysis (standardless and with use of standards) guaranteed for full required energy range 0 – 30 keV.
	Spectra import and export in open format (EMSA).
	Point analysis, line analysis, rectangle area analysis and freehand area quantitative analysis.
	Elemental distribution mapping (in range Be-Cf) includes also quantitative elemental distribution mapping. Resolution for all elemental distribution maps 8000 x 8000 points.
	Elemental linescanning includes also quantitative elemental linescanning. Resolution for all linescans 8192 points.
	Phase detection, phase analysis, analysis of chemical composition of phases, modal analysis.
	Full and automated SEM stage operation (x, y, z axes at least) from EDS software.
Reactive and predictive drift correction included. Use of both corrective methods simultaneously.	

	Integrated solution for resolution of spectral peaks overlaps based on deconvolution methods, pulse pile-up correction for all pulse pile-ups peaks of 1 st -3 rd order during data acquisition for all qualitative and quantitative data includes also elemental distribution maps and linescans.
	One off line license for all supplied analytical software.
	All supplied software update for at least 5 years free of charge.

Table 4: Computer

Hardware	64-bit computer with core i7 or better.
	Two hard drives SSD of capacity 250 GB each.
	16 GB RAM.
	Provided with Windows 10 Pro 64-bit
	Dual full HD monitors of size 24 inch.
	Mouse, keyboard, trackball

Table 5: Microscope control software, imaging and image processing tools

Software compatibility	Compatible with Windows 10
Software characteristics	Software integrate controls for main microscope functionalities in one application, provide intuitive and easy access to all microscope functions, monitor and inform user about state of the individual subsystems, displace, rotate and tilt the sample stages, protect sensitive parts of microscope from operation under dangerous conditions.
Remote access	Remote access to the SEM.
Updates and support	Support and maintenance for the software is available and updates regularly provided
Other software features	Support of multiuser mode.
	Examiner SW, provide diagnostic function of the entire system
	Focusing window inside scanning window.
	Dynamic focus for non-flat surfaces.
	Measurement of distances and dimensions in the image with precision 2,99%.
	Saving images in common formats (TIFF, BMP, JPG, GIF, JPEG2000, PNG, PGM, PPM)
	Possibility to save images in high resolution, at least 16384 x 16384 px.

Table 6: Sputter coater

Vacuum	Operating with vacuum level corresponding to residual pressure of 2x10 ⁻² mbar or less
	Vacuum components necessary for operation must be part of delivery and installed by supplier.
Sample coating	Au, Ag and Pt sputtering targets.
	Automatic sputtering procedure.
	Possibility to predefine and store sputtering conditions by user.
	Chamber diameter at least 120 mm in diameter and 100 mm in height.

	Metal film thickness monitor included
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Table 7: Magnetic field shielding system

Magnetic field shielding type	Active shielding to compensate external magnetic field in the region of the SEM column and chamber. Field components measured by at least one provided sensor. The solid frames holding the wiring meant to produce the cancellation fields must be supplied and their construction adapted to ensure sufficient field cancelation inside the shielded space.
Bandwidth of the shielded field	DC – 5 kHz
Minimal dynamic range	4.8 μ T pk-pk
Field cancelling factor	100 or higher at 50/60 Hz
	400 or higher at DC

Table 8: Accessories

Calibration standards	Resolution AU-C test specimen
	Calibration standard samples for EDS composition analysis.
Accessories for microscope operator	Dust-free gloves.
	Stainless steel tweezers.
	Conducting tape compatible with vacuum environment
	Non-conducting tape compatible with vacuum environment.
	Stubs for attaching samples, compatible with stage carousel, and plastic boxes for stubs storage and transportation.
	Special sample holders. At least tilted and higher holder.
	Box with tools necessary for microscope parts maintenance containing at least screw drivers, dust-free wipers, IPA or other chemical for cleaning of vacuum parts.

Table 9: Conditions of delivery, warranty and service, training

Delivery	All parts that are subject of this tender will be delivered till 5 months from the date of the order.
Warranty must include	Warranty 36 months for all parts of microscope including vacuum system, active vibration isolation, AC+DC field cancelation system, sputter coater and EDS system.
Service	Service response no later than three days from written report including service and support for third party components (EDS, AC+DC field cancelation, vibration isolation system ...). Team Viewer on-line diagnostics
Replacement of parts with limited lifetime	Similar parts must be available to replace at least five years after the date the microscope has been purchased. This means that replacement will not cause to downgrading of these specifications.
Training	3 days for SEM and EDS



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ANNEX NO. 2 SELLER'S BID

Scanning Electron Microscope TESCAN MIRA3 LMH and all its accessories:

- Scanning Electron Microscope TESCAN MIRA3 LMH with detectors and accessories defined by the requirements, electronics, PC and backup power supply.
- EDS AZtec Advance Ultim Max Extreme + Ultim Max 100 from Oxford Instruments
- Vacuum system with prolonged pipes customized according to laboratory layout.
- Spicer SC24 DC/SEM/EU including a octagonal frame, system for AC and DC magnetic field shielding.
- Active system integrated into microscope frame for damping external mechanical vibrations.
- Quorum Q150 RS Plus, sputter coater for noble metal coatings.
- Installation of device and all its parts.
- On-site training.
- Warranty and service.

Specification of the High Resolution Schottky FE-SEM

MIRA3 LMH

(Large Chamber, Extended Motorized Stage, High Vacuum Operation)

A fully PC controlled high resolution FE-SEM intended for high vacuum operations. Outstanding electron-optical properties, flicker-free digital image with super clarity. Sophisticated user-friendly software for microscope control and image capturing using Windows™ platform. Standard formats of stored images, easy image management, processing and measurements, automatic set up of the microscope and many other automated operations are characteristic features of the equipment.

The Most Important Features:

- ♦ High brightness Schottky emitter for high-resolution / high-current / low-noise imaging
- ♦ **In-Beam SE Detector** (optional) for inside-the-column detection of electrons at short working distances
- ♦ Unique three-lens **Wide Field Optics™** design offering the variety of working and displaying modes embodying the TESCAN proprietary Intermediate Lens (IML) for the beam aperture optimization
- ♦ Real time **In-Flight Beam Tracing™** for the performance and beam optimization integrating the well-established software Electron Optical Design. It includes also direct and continual control of beam spot size and beam current
- ♦ **Beam Deceleration Technology (BDT)** for excellent resolution at low beam voltages (optional)
- ♦ **In-Beam BSE Detector** for BSE imaging at very short working distances (optional)
- ♦ Fast imaging rate
- ♦ High-throughput large-area automation, e.g. automated particle location and analysis
- ♦ Superior specimen handling using a motorized compucentric stage
- ♦ Ideal geometry for EDX and EBSD, non-distorted EBSD pattern
- ♦ Fast and easy obtaining of the clean chamber vacuum by powerful turbomolecular and dry fore vacuum pump. Electron gun pumping by ion getter pump
- ♦ Fully automated microscope setup including electron optics setup and alignment
- ♦ Sophisticated software for SEM control, image acquisition, archiving, processing and analysis. Multi-user environment localized in many languages
- ♦ Network operations and built-in remote access/diagnostics, all come as the TESCAN standard
- ♦ Unique live stereoscopic imaging utilizing the **3D Beam Technology**

TESCAN technologies are protected by patents, for instance US7193222, EP2082413, DE202008018179, CZ 301692, US8779368, CZ305388, EA021273, CZ 304824, CZ305883 and others.

Electron Optics:

Electron Gun:	High brightness Schottky emitter		
Resolution:	SE	In-Beam SE (option):	BD mode (option):
	1.2 nm at 30 kV	1.0 nm at 30 kV	-
	1.5 nm at 15 kV	1.2 nm at 15 kV	-
	2.5 nm at 3 kV	2.0 nm at 3 kV	1.5 nm at 3 kV
	4.5 nm at 1 kV	3.5 nm at 1 kV	1.8 nm at 1 kV
			2.5 nm at 200 V

STEM detector (option):
0.8 nm at 30 kV

In-Beam BSE (option):
2.0 nm at 15 kV

Magnification at 30kV:
2×– 1,000,000×
(for 5'' image width in Continual Wide Field / Resolution mode)

Field of View:
6.4 mm at $WD_{analytical}$ 10 mm
20 mm at WD 30 mm

Electron Beam Energy:
200 eV to 30 keV / down to 50 eV with BDT option

Probe Current: 2 pA to 200 nA

Electron Optics Working Modes:

Resolution: High-resolution mode
Depth: Sets the column up in a mode that enhances depth of focus
Field: Optimizes the column to provide a large non-distorted field of view
Wide Field: Provides an extra-large non-distorted field of view for extra low magnification imaging
Channeling: Working mode for assessment of crystal orientation data of the specimen, acquiring of electron channeling pattern (ECP)

Scanning:

Scanning Speed: From 20 ns to 10 ms per pixel adjustable in steps or continuously
Scanning Features: Point & Line Scan
 Focus Window – shape, size and position continuously adjustable
 Dynamic Focus – in plane or folded plane tilted up to ± 70 deg
 Image rotation, Image shift, Tilt compensation
 3D Beam – defined tilting scanning axis around XY axis
 Live Stereoscopic Imaging
 Other scanning shapes available through the optional DrawBeam software

Vacuum System:

Chamber Vacuum: $< 9 \times 10^{-3}$ Pa*

Gun Vacuum: $< 3 \times 10^{-7}$ Pa

Pumping Time after Specimen Exchange: typically < 3 minutes

* pressure $< 5 \times 10^{-4}$ Pa can be displayed with optional WRG vacuum gauge (on request)

Chamber:

Chamber: Internal dimensions: \varnothing 230 mm

Door width: 148 mm

Number of ports: 11⁺

⁺ configuration and number of ports can be modified to customer's needs

Chamber and Column Suspension:

Standard: Pneumatic

Optional: Active vibration isolation (integrated)

Specimen Stage:

Type: Compucentric, fully motorized

Movements: X = 80 mm (−40 mm to +40 mm)

Y = 60 mm (−30 mm to +30 mm)

Z = 47 mm

Rotation: 360° continuous

Tilt: −80° to +80° (WD and sample size dependent)

Maximum Specimen Height:

54 mm (with rotation stage)

81 mm (without rotation stage)

Note: Range of the movements can be dependent on WD and configuration.

Detectors:

Standard:

SE	Secondary electron detector of Everhart-Thornley type (monocrystal scintillator)
pA Meter	Probe Current Measurements
Touch Alarm	Stops movements when sample touches any part of the chamber
IR TV Camera	For live „Chamber View“

Optional¹:

In-Beam SE	Detector of secondary electrons located in the objective and intended for high resolution and short working distances
Beam Deceleration Technology (BDT) package	Intended for the highest resolution at low beam voltages includes system for negative voltage biasing of the sample stage and new in-beam detector that works either as SE detector (in BD mode) or BSE detector (in standard mode). BDT package includes decontaminator as standard.
Beam Deceleration Technology (BDT) option	Intended for the highest resolution at low beam voltages includes system for negative voltage biasing of the sample stage and new in-beam detector that works either as SE detector (in BD mode) or BSE detector (in standard mode). This option does not include decontaminator.
Retractable BSE*	Retractable annular detector (scintillator type) for wide-angle back-scattered electrons with high sensitivity and atomic number resolution (0.1)
In-Beam BSE	Annular, scintillator-based back-scattered electron detector mounted in-column that enables to obtain BSE images at very short working distances
In-Beam LE-BSE	Annular, scintillator-based back-scattered electron detector mounted in-column enabling capture of BSE images at low energies and very short working distances; collects axial electrons
LE-BSE*	Specially-designed, retractable, annular back-scattered electron detector (scintillator type) for low energy imaging down to 200 eV
Retractable Dual Scintillator BSE*	Retractable annular back-scattered electron detector of scintillator type with high sensitivity and atomic number resolution (0.1) equipped with additional monocrystal scintillator from side for enhanced topographic contrast
Retractable 4-Quadrant semiconductor BSE *	Retractable semiconductor back-scattered electron detector for signal acquisition from all four quadrants separately
STEM	Transmitted electron detector; Bright Field and Dark Field imaging
HADF R-STEM**	Retractable version of STEM detector for simultaneous acquisition of the Bright Field (BF), Dark Field (DF) and High Angle Dark Field (HADF) signals
CL *	Retractable panchromatic cathodoluminescence detector, two wavelength ranges available: 350 nm – 650 nm; 185 nm – 850 nm

Rainbow CL*	Retractable color as well as panchromatic cathodoluminescence detection in separate channels. RGB image processing is fully integrated in microscope control software; no external scanning, wavelength range 350 nm – 850 nm
Compact CL	Modified CL detector specially designed for simultaneous CL and BSE detection
Rainbow CL (Compact)	Modified Rainbow CL detector specially designed for simultaneous CL and BSE detection
Al-coated BSE*	Specially designed BSE detector for simultaneous CL and BSE detection
BSE/CL	Combined retractable, 350 nm – 650 nm
EBIC	Electron beam induced current detection
EasyEDX***	Super-integrated O.E.M. EDX microanalyser
EDX***	Take off angle: 35° at WD 15 mm; 30° at WD 10 mm
WDX*****	Take off angle: 35° at WD 15 mm; 30° at WD 10 mm
EBSD***	Electron back-scattered diffraction

* motorized mechanics as an option

** equipped with motorized mechanics

*** fully integrated third party products

**** integrated active vibration isolation necessary

Notice: It is strongly recommended to use Al-coated BSE detector in case of simultaneous CL and BSE detection.

Optional Accessories¹:

Peltier Cooling stage
 Beam Blanker for SEM column
 Load Lock
 Control Panel
 Optical Stage Navigation
 Nanomanipulators
 Decontaminator/plasma cleaner

¹Possible combinations of optional detectors and other accessories must be discussed with TESCAN Brno.

UPS 2kW is standard part of delivery.

Microscope Control:

All microscope functions are controlled by keyboard, mouse and trackball via the program MiraTC using Windows™ platform.

Computer: **PC Standard**
Intel® Core i3-4160 Dual Core 3.60 GHz, RAM 8GB, HDD 500GB, nVIDIA GT730 2GB DDR3, Windows 10 Pro 64-bit, Certification: CE

Option1: **PC High Performance**
Intel® Core i7-4790 Quad Core 3.60 GHz, RAM 16GB, HDD 2TB, nVIDIA GTX960 2GB GDDR5, Windows 10 Pro 64-bit, Certification: CE

Option2: **PC Dell Precision 3620**
Intel® Core i7-6700 Quad Core 3.40 GHz, RAM 16GB, HDD 2TB, AMD FirePro W5100 4GB, Windows 10 Pro 64-bit, Certification: CE, CCC

The manufacturer reserves the right to change the computer specification according to the topical situation in the computer market.

Image Display: 24" LCD HP FullHD

Image Size: 16,384 × 16,384 pixels, adjustable separately for live image (in 3 steps) and for stored images (11 steps), selectable square or 4:3 or 2:1 rectangle

Large Panorama Image Size: Unlimited (up to storage capacity)

Image Formats: BMP, TIFF, JPEG, JPEG2000, GIF, PNG, PGM, PPM

Image Depth: Up to 16 bits per channel

Remote Control: Via TCP/IP, open protocol

Automated Operations:

- ♦ In-Flight Beam Tracing™ beam optimization
- ♦ Spot Size and Beam Current Continual
- ♦ WD (Focus) & Stigmator
- ♦ Contrast & Brightness
- ♦ Scanning Speed (according to Signal - Noise Ratio)
- ♦ Gun Heating
- ♦ Gun Centering
- ♦ Column Centering
- ♦ Vacuum Control
- ♦ Compensation for kV
- ♦ Look Up Table
- ♦ Auto-diagnostics

Software extensions:

Standard:

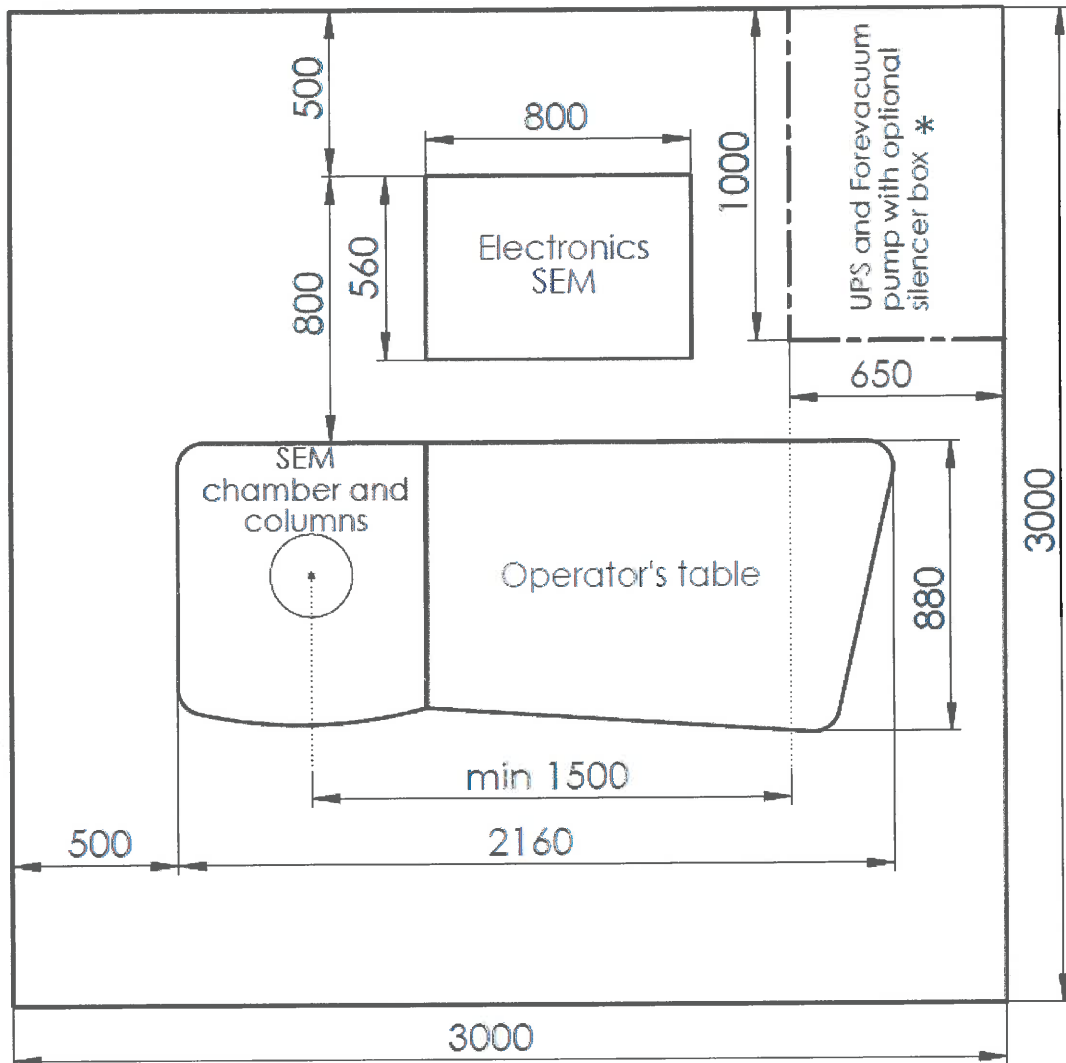
- ◆ Analysis & Measurement
- ◆ Histogram
- ◆ Image Processing
- ◆ 3D Scanning
- ◆ Hardness
- ◆ Multi Image Calibrator
- ◆ Object Area
- ◆ Switch-Off Timer
- ◆ Tolerance
- ◆ X-Positioner
- ◆ Live Video
- ◆ EasySEM™

Optional:

- ◆ Particles Basic
- ◆ Particles Advanced
- ◆ Sample Observer
- ◆ Image Snapper
- ◆ DrawBeam Basic
- ◆ DrawBeam Advanced
- ◆ EasyEDX Integration Software
- ◆ TESCAN TRACE GSR
- ◆ 3D Metrology (MeX)
- ◆ System Examiner
- ◆ Cell Counter
- ◆ Coral (Correlative microscopy module for Life Sciences)
- ◆ SYNOPSIS Client (Correlative microscopy module for semiconductor applications)

For more information about software items see the specification Software Extension Modules.

Footprint of the Microscope (all dimensions in mm):



If a fore-vacuum pump is to be placed in the same room as the MIRA microscope, then it is highly recommended to purchase the TESCAN silencer box together with the microscope.

Installation Requirements:

Power:	230 V \pm 10%/50 Hz (or 120 V/60 Hz - optional), 2200 VA
No water-cooling	
Compressed air:	600 – 800 kPa (6 – 8 Bars)
Compressed nitrogen for venting:	150 – 500 kPa (1.5 – 5 Bars)
Room for installation:	min. 3 m \times 3 m; min. door width 0.9 m

Environmental Requirements:

Temperature of environment:	17 – 24 °C with stability better than 2°C with the rate of change 1°C/hour (0.017°C/min)
Relative humidity:	< 80 %
Background magnetic field:	synchronous < 300 nT asynchronous < 100 nT
Vibrations:	
For pneumatic suspension:	< 5 μ m/s below 30 Hz < 10 μ m/s above 30 Hz
For active isolation:	< 10 μ m/s below 30 Hz < 20 μ m/s above 30 Hz
Acoustic noise:	Less than 60 dBC
Altitude:	max. 3000 m above sea level

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Wide Field Optics™, In-Flight Beam Tracing™ and EasySEM™ are trademarks of TESCAN Brno, s.r.o.
Windows™ is a trademark of Microsoft Corporation.

We are constantly improving the performance of our products; so all specifications are subject to change without notice.

Large Area Silicon Drift Detector

Ultim Max performance reaches new levels of size and sensitivity.

Large sensor = Maximum counts.

Coupled with **Extreme** electronics, means higher throughputs as well as increased counts provided by Ultim Max due to large solid angles.

Ultim Max allows the same excellent resolution at higher count rates:

Quant Analysis at >400,000cps

Mapping at >1,000,000cps

In addition, improved sensitivity for low energy X-rays means that not only is Be guaranteed, but also Si LI and Al LI lines are commonly detected.

Detector	Sensor area (mm ²)
Ultim Max 40	40
Ultim Max 65	65
Ultim Max 100	100
Ultim Max 170	170

Resolution Guarantees	Resolution guaranteed and tested on installation using an X4 pulse processor, between 10°C and 30°C up to 1,500m Ultim Max 40, 65, 100 and 170 <ul style="list-style-type: none"> • Mn Kα resolution guaranteed to be less than 127 eV at 130,000 cps • F Kα resolution guaranteed to be less than 64 eV at 130,000 cps • C Kα resolution guaranteed to be less than 56 eV at 130,000 cps Premium (Ultim Max 40, 65, 100) <ul style="list-style-type: none"> • Mn Kα resolution guaranteed to be less than 124 eV at 50,000 cps • F Kα resolution guaranteed to be less than 58 eV at 50,000 cps • C Kα resolution guaranteed to be less than 48 eV at 50,000 cps
Detection Range	Detection from beryllium (Be) to californium (Cf)
Low Energy Performance	Incorporates SATW Ultra Thin Polymer Window for the best low energy performance. All Ultim Max detector resolution specifications are guaranteed in compliance with ISO15632:2012
Cooling	LN ₂ -free, vibration free, Peltier Cooling <ul style="list-style-type: none"> • Requires only an electrical supply • No external compressors, chillers, or gas lines required – no vibration



*The Business of Science**



As Standard:

Motorised slide

Extreme electronics ensuring accurate results at all count rates. Includes pulsed restore for performance at high throughput and a stable response with changing count rate

Unique vacuum reservoir specifically designed for increased detector lifetime and improved light element performance

Uniquely designed to operate in any orientation – ideal for fitting multiple geometries.

Customised detector interface for your microscope with 'O' ring vacuum seals to the chamber and vacuum bellows seal to the detector probe

Manufactured under ISO9001 standard

Geometry design with an optimal take off angle to maximise count rates and solid angle (specific to each microscope)

X4 pulse processor and imaging electronics

X4 is the latest generation pulse processor with fully integrated microscope digital control and image capture. X4 uses fully digital pulse processing for accurate handling of very high count rates. Ethernet high speed communications connect with the analyser PC

Digital pulse processing and control for up to 4 EDS detectors

Effective pile-up discrimination when working at very high count rates

Simple automatic system calibration

Six process times to provide full control of count rate and resolution

4 imaging inputs

Microscope X,Y beam control

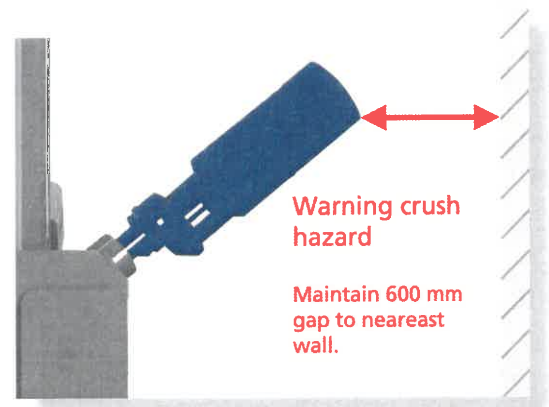
External synchronisation of beam position for EBSD

Ultim Max environmental specification

These requirements are necessary for the installation and operation of the system and are the responsibility of the purchaser.

Operating temperature: 10°C to 30°C

Operating humidity: <80% relative humidity, non-condensing



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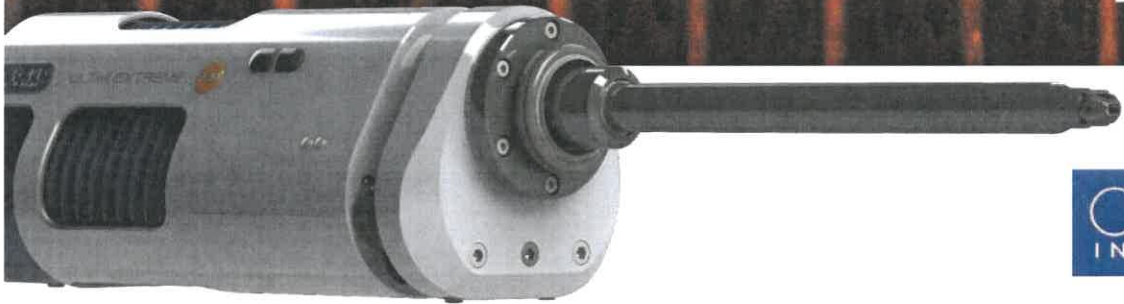
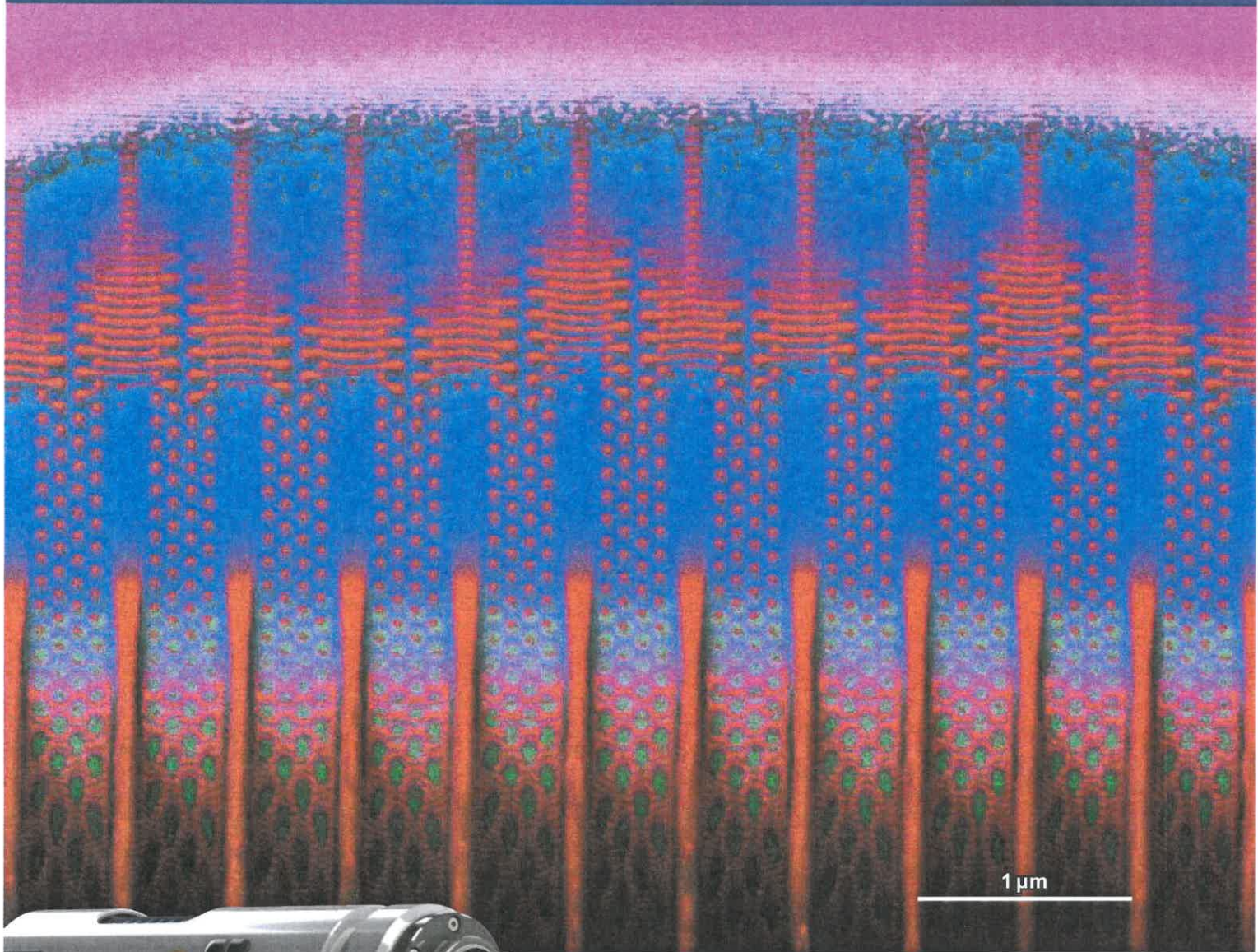


THE QUEEN'S AWARDS
FOR ENTERPRISE
INNOVATION
2011

EDS

Ultim[®] Extreme Silicon Drift Detector

Delivering solutions beyond conventional nano-analysis in the SEM

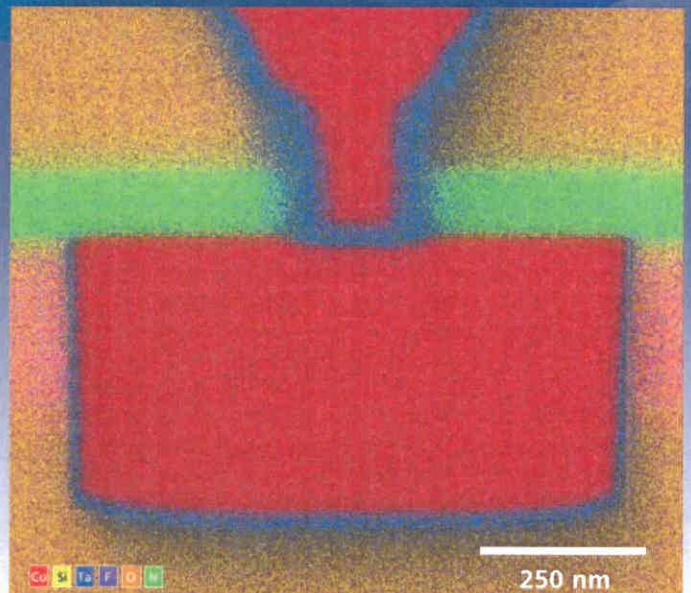
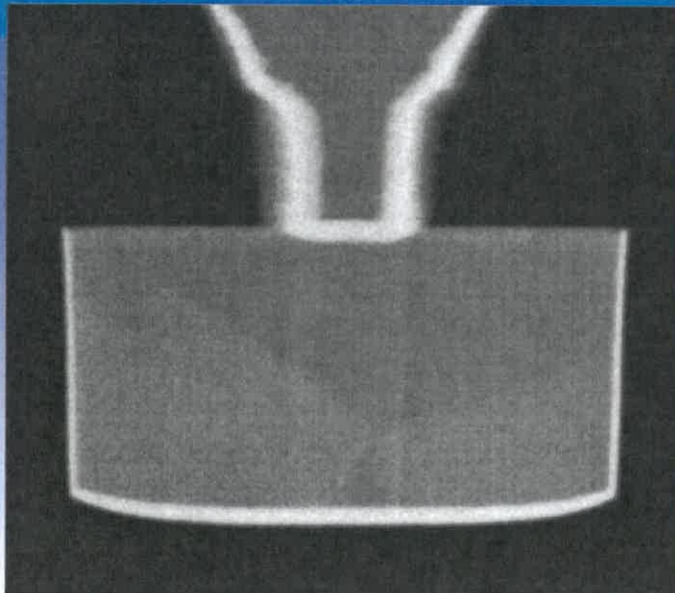


OXFORD
INSTRUMENTS



Ultim Extreme

Solutions beyond conventional nanoanalysis in the FEG-SEM...



Analysis of a bulk cross section of a smart phone SRAM device: the EDS X-ray map resolution approaches that of the SEM image. Data courtesy of MSS Corp.

A spatial resolution and sensitivity breakthrough for EDS in the FEG-SEM

Ultra-high resolution FEG-SEMs offer exciting new capabilities for the investigation of smaller nano-structures, interfaces and surfaces. However, under the operating conditions used to make use of new electron signal contrasts from in-lens detectors - very short working distance, very low kV and minimal beam current - no traditional SDD can provide supporting elemental characterisation.

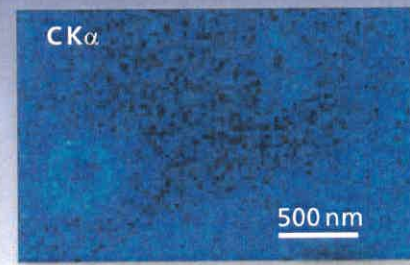
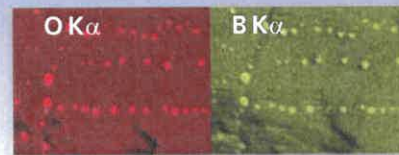
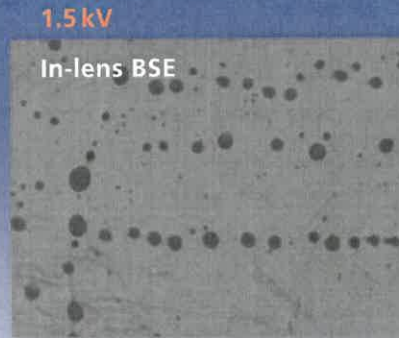
Until now. With **Ultim Extreme**, both imaging and EDS are performed simultaneously, while the EDS resolution approaches that of the SEM itself.

Radical new geometry maximises sensitivity and spatial resolution in FEG/FIB-SEM:

- Highest sensitivity conventional port-mounted EDS detector
- Windowless operation
- Typically 15x greater sensitivity at low kV than conventional large area SDD
- Unique shape 100mm² sensor for short working distance operation
- Reduced footprint electron trap configuration allows qualitative analysis up to 7kV beam voltage
- Use immersion field to extend quantitative range up to 15kV and beyond
- New electronics boost sensitivity to very low energy X-rays and extends the low energy analytical performance at higher count rates
- Enhanced Tru-Q™ software turns the X-ray data into practical and accurate elemental information at this unrivalled spatial resolution

EDS resolution approaches that of the FEG-SEM

...new possibilities, better spatial resolution, more sensitivity



Reducing accelerating voltage from 10kV to 1.5kV allows electron image contrast to show the distribution of oxide particles. X-ray mapping under the same conditions characterises precipitates as MnOB.

X-ray map collected at 1kV to characterise high-end electronic component stain detected using In-lens SE imaging.

Sub 10 nm element characterisation

Achieving practical EDS count rates and spectral quality at 2kV or less, combined with short working distance for optimum beam size means unrivalled spatial resolution for element characterisation is now possible:

- Practical sub 10nm element characterisation on real materials in the FEG/FIB-SEM
- X-ray map resolution close to SEM image resolution
- Characterise smaller nano-structures, particles and materials
- Use bulk samples to reduce workload on TEM and sample preparation time

Materials characterisation down to 1kV

The latest in-lens detectors provide new types of image contrast for new information about nano-structures.

Ultim Extreme works at the same collection conditions to add elemental information to this new image information.

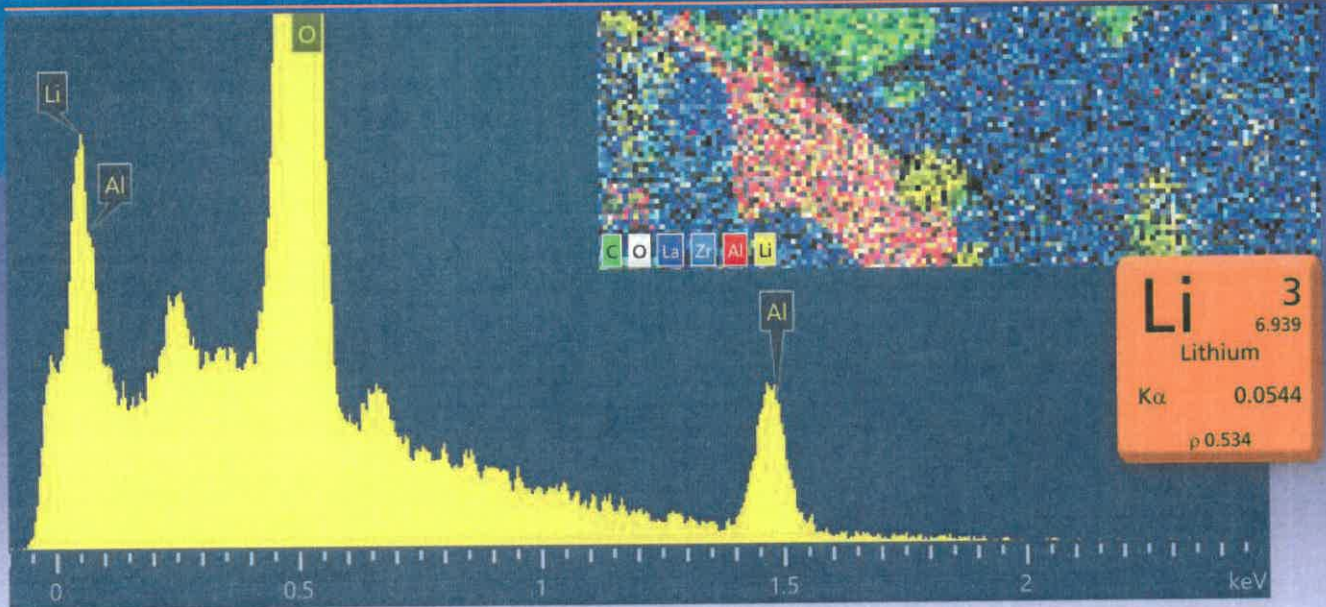
- Fully integrate EDS where very low kV electron microscopy benefits sample characterisation
- Enhanced signal contrast
- Reduction of sample damage e.g. for polymers and soft coatings
- Reduce charging, or achieve charge balance conditions

Surface science sensitivity

At very low accelerating voltages, X-ray information is emitted from the top few nm or atomic layers only, making the elemental characterisation of surfaces in the FEG/FIB-SEM possible:

- Characterise the composition and distribution of surface contaminants and layers a few atoms thick
- Integrate characterisation of surfaces with SEM investigation
- Analyse the surface structures only visible with in-lens detectors at very low kV and short working distance
- Save money and time compared to Auger/XPS

Ultim Extreme



Spectrum collected from LiAlO grain in a LiLaZrAlO solid battery electrolyte.

EDS map of solid electrolyte showing LiK α mapping (yellow)

Fastest and most accurate nano-characterisation

Ultim Extreme collects more and better quality EDS data at higher spatial resolution. With the **AZtec** Tru-Q™ processing engine, this provides the fastest, most accurate characterisation possible in the FEG/FIB-SEM.

- High speed collection
- Unrivalled low energy spectrum quality and integrity
- Real-time data processing
- Rapid autoID and TruMap peak overlap correction of low energy X-ray lines

Extreme light element sensitivity

The windowless configuration and ultra high sensitivity of **Ultim** Extreme offers the most sensitive light element detection.

- Up to 15x increase in signal over conventional detectors
- Work at lower kV to minimise sample damage and charging
- New potential for the detection and characterisation of difficult elements, such as nitrogen
- New ability to analyse polymers and soft biological materials

Lithium detection and mapping

Oxford Instruments announced the first successful detection of Li X-rays by EDS in 2012. We have developed this know-how adding new ultra low noise electronics for the detection of X-rays below 100 eV.

- First detection and X-ray mapping of Li K α (only 56 eV)
- First detection of lithium in compounds e.g. LiH, Li₃N, Li₂O, Li₂S, LiF and LiCl by EDS
- First characterisation of Li in battery materials

nano.oxinst.com/ultim-extreme

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AZtecLive will change the way users perform sample investigation in the electron microscope by taking the EDS technique from the static to the dynamic with real-time chemical imaging.

AZtecLive comes in three packages and each package includes the new '**AZtecLive**' step, which enables the quick and comprehensive investigation of a sample with real-time chemical feedback via Live X-ray Maps/Spectrum and interactive 'Live Trace'.



The **Standard** package

includes all the tools required to perform qualitative and quantitative analysis, image capture, image centric analysis and X-ray spectral mapping and line mapping. With Tru-Q®, AutoID and standardless analysis can be achieved automatically to levels of accuracy only previously possible using manual optimisation. Includes functionality for acquiring X-ray maps and linescans, and functionality that automatically turns information contained in a set of X-ray maps into a single image to visualise both phase and chemical variation in a specimen (AutoLayer). Contains Analyser, Point&ID, Mapping, linescan and Optimize Navigators.

The **Advanced** package includes functionality for acquiring overlap and background corrected X-ray maps and linescans in real-time (TruMap and TruLine) and view the element concentration variations over these X-ray maps and LineScans (QuantMap and QuantLine), and unique reactive and predictive specimen drift correction functionality (AutoLock).

The **Auto** package contains sophisticated functionality for unattended data collection, and a dedicated particle analysis package.

Each package comes with a choice of one of our world beating LN₂-free **Ultim** Max Large Area SDD detectors with sensor sizes of 40mm², 65mm², 100mm² and 170mm².

AZtecLive Step

AZtecLive enables the quick and comprehensive investigation of a sample with real-time chemical feedback via Live Image / X-ray Maps / Spectrum and interactive 'Live Trace'

Users can navigate their sample while watching:

- LIVE TV mode electron image
- LIVE TV mode X-Ray maps
- LIVE automatically peak labelled spectrum
- All continuously updated LIVE within the **AZtec** interface

Image Acquisition

- Acquires a TV mode SE or BSE image within the AZtecLive interface
- Dwell times down to 1 μ sec
- Automatically transition between responsive live imaging mode when navigating around your sample - and high quality imaging mode when something of interest is seen and the stage is stopped

X-Ray Mapping

- Acquires TV mode X-Ray maps matching the live image acquisition feed
- Dwell times down to 1 μ sec
- Automatic transition between responsive live mapping mode when navigating around your sample - and high quality mapping mode when stage is stopped

Spectrum

- Acquires a continuously refreshed sum spectrum of the whole image area with automatically labelled peaks
- Automatically transition between responsive live spectrum mode when navigating around your sample - and high quality spectrum mode when something of interest is seen and the stage is stopped
- In 'Spot Mode' – Both the image and X-Ray maps are frozen to allow the user to select points on the image or maps to acquire a dedicated point analysis spectrum

Live Trace

- Automatically records locations visited on the sample along with what elements have been detected.
- Choice of viewing stage locations or element locations
- Element location view also shows concentration information view opacity level
- Stage can be relocated to any previously analysed area (only during the analysis session)

Data Saving

- Data can be saved at any time, in the form 'of a site of interest' in the data tree (Consisting of Image, SmartMap and Spectra)

Patent Pending

Many aspects of **AZtecLive** are covered by a pending patent.



The Business of Science®

Operating Modes

- Guided (Navigator driven operation)
- Custom (Flexible software architecture, with multiple monitor support)

Navigators

AZtec® is equipped with several navigators, which are designed to help you perform tasks quickly, easily and consistently

- Optimise
- Analyser
- Point&ID
- Map
- LineScan
- LayerProbe (optional)
- Particle Analysis (optional)

Image

- Resolutions (64, 128, 256, 512, 1024, 2048, 4096 and 8192 pixels wide)
- Dual image capture (for microscopes that have multiple image outputs)
- Frame averaging (Kalman)
- Variable scan speeds from 1 µsec dwell to 800 µsec in 1 µsec interval with 6 quick selections of 1, 5, 10, 100, 400
- Continuous scanning mode with the ability to scan over a reduced area of the image

Spectrum Acquisition

- Acquire from point, rectangle, ellipse or freehand area
- Number of channels 1024, 2048, 4096 and Auto (Auto selects the most appropriate energy range 10, 20, 40 keV and Default)
- Process time 1, 2, 3, 4, 5, 6 and Default
- Acquisition Mode:
 - Auto - Terminates when 300Kcts have been collected
 - Counts – Terminates when user specified counts have been collected
 - Live Time - input variable 0.1 to 604800sec
- Pulse Pile-up Correction

- Choice of viewing spectra in Counts or CPS/eV
- Show/hide noise peak
- Linear and logarithmic y-scale options
- Normalise spectra about a point or energy range

MiniQuant

- Overlaid in spectrum viewer
- Shows bar chart or numeric values of quantitative analysis results for detected elements
- Results can be shown in Weight%, Atomic% or Oxide%
- Overlay a spectrum from any project in the Data Tree over the current spectrum
- Direct access to quant settings: normalisation and processing options: all elements, oxygen by stoichiometry or element by difference

Confirm Elements Step

- Spectrum overlays:
 - Element series line markers
 - Candidate element peak shapes
 - Fitted spectrum
 - Theoretical spectrum
 - No pulse pile-up correction
 - Candidate element viewing window
 - Peak label editor
 - Create a peak label scheme manually that can be saved to a profile for future use

Calculate Composition Step

- Choice of 7 templates for different views of data:
 - Summary table (Single and multiple spectra)
 - Comparison of results (Two Spectra)
 - Full results (customisable – single spectrum)
 - Spectrum details
 - Spectrum processing
- Quant results output in Weight%, Atomic% and Oxide%
- Processing options (All elements, element by difference or oxygen by stoichiometry)
- Enable coating correction, automatic line selection, normalisation, results thresholding

Deconvolution elements
 Add elements of known composition
 Create fixed element lists
 Batch spectrum processing capabilities over sites, samples and projects

SmartMap – X-Ray Mapping

Collects spectral map datacube
 X-ray map resolutions of 64, 128, 256, 512, 1024, 2048 and 4096 pixels (Montaged X-ray maps with resolutions up to 8192 pixels can be processed)
 Termination by number of frames or user intervention
 Number of channels 1024, 2048 and Auto (Auto selects the most appropriate)
 Energy range 10, 20, 40 keV and Auto
 Process time 1, 2, 3, 4, 5, 6 and Default
 Order maps by max intensity, mean intensity, atomic number or alphabetically
 Binning factors: 1, 2, 4, 8, 16 and 32
 Layered Image view consisting of coloured X-ray maps overlaid on the electron image with associated colour key
 Reconstruct spectra from a point, rectangle, ellipse or freehand region for qualitative and quantitative analysis
 Discrete Colour scheme visualises variations in CPS
 Capability to extract from a SmartMap:

- a single pixel linescan in any orientation
- a single variable thickness linescan in a horizontal or vertical direction
- a set of multiple linescans in a horizontal or vertical direction

SmartLineScan – X-ray LineScanning

Line definition

- Points (up to 8192 points allowed per line)
- Separation (Line length dependent)

Termination by number of frames or user intervention
 Number of channels 1024, 2048 and Auto (Auto selects the most appropriate)
 Energy range 10, 20, 40 keV and Auto
 Process time 1, 2, 3, 4, 5, 6 and Default
 Views (vertical tiles, stacked with normalised/unnormalised intensity)

Binning factors: 1, 2, 4, 8, 16 and 32
 Calliper measurements available in each linescan view
 Reconstruct spectra from each point or binned region of the linescan
 Capability to acquire a set of multiple linescans in a horizontal or vertical direction

Info tool

Gives data sensitive feedback when used on spectra, images, maps and linescans.

Reporting

Comprehensive list of Word and Excel templates

- Filter template list based on Favourites, Document type (Excel/Word), Page orientation, Paper Size, Category and Technique
- Template preview available (requires Microsoft Office)
- Default report templates can be assigned to individual navigators

Batch templates (generate the same report type for multiple sites of interest)

Site report (prints out a report of all data in a 'site of interest')

Report Template Generator

- Allows the user to create or customize report templates

Exporting

Images, Spectra, X-ray maps, LayerMaps and LineScans can be saved, copied, printed and e-mailed directly from the AZtec interface via 'right mouse click' menu

Images can be saved as Bitmaps (.bmp), Graphics Interchange Format (*.gif), Joint Photographic Group (*.jpg and *.jpeg), Portable Network Graphics (*.png) and Tagged Image File Format (*.tif and *.tiff)

Spectra can be saved as bmp, gif, jpg, jpeg, png, tif or tiff files

X-ray maps and LayerMaps and Linescans can be saved as bmp, gif, jpg, jpeg, png, tif or tiff files

Image export settings that can be altered for export: width, height, units (pixels, inches and cm), aspect ratio, header, user annotation, colour key, colour bar, scale bar

Spectra export settings that can be altered for export: width, height, units (pixels, inches and cm), aspect ratio, show vertical scale, show horizontal scale, vertical scale type (linear or logarithmic), show peak labels, show annotations, normalise spectrum, spectrum smoothing, monochrome spectra,

Spectra export in EMSA format

X-ray map and Linescan data export as .TSV, .CSV and RAW (for Lispix, MSA etc...)

Batch Export Facility allows the user to select multiple images and maps within multiple projects and export them in one action. Batch Export options are:

- EDS and EBSD images and maps in BMP, PNG, JPEG or TIF format
- EDS maps in Raw TIF, Raw CSV and Raw TSV formats
- Export EDS maps into element specific folders
- Export Images into a choice 'Project', 'Specimen' or 'Site' folders

Copy to Clipboard facility for:

- Quant tables
- Linescan tables
- Step Notes

AutoLayer

AutoLayer visualises both phase and element distribution using a single image

Works with both SmartMaps and TruMaps

Automatically assigns colours for up to 7 maps

Optimise

Energy calibration

Beam Measurement for accurate un-normalised quantitative analysis

Standardisation manager

- System is supplied with default set of standardisations
- User can standardise on standard materials for quantitative analysis
- Set-up Multiple standards files for different analysis requirements
- View and manage standards files including transfer of standardisations between files
- Standardisations saved with a profile, thus allowing multiple standardisations to be available to users

User Profiles

User Profiles contain:

- Image acquisition settings

- Spectrum acquisition settings
- X-ray map acquisition settings
- Linescan acquisition settings
- Peak label settings
- Quant settings
- Step notes

There is no limit on the number of profiles that can be saved

Export profiles (along with standards file) to a remote system to repeat a process or confirm analysis

Support Panel

DataView

- Shows Data Tree and Current Site

MiniView

- Shows relevant data views for each navigator step (Image, spectra, count rate etc..)

StepNotes

- Shows step sensitive help
- Can be edited to show personalised help that can be saved with a profile to incorporate Standard Operating Procedures

Options

AutoLock – Drift Correction

Predictive and reactive drift correction routines available



Tracking image up to 4096 pixels

Dwell time up to 800ms

Automatic or manual measurement interval setting

Drift correction modes

- In-Field
- Extended

Maximum drift setting (full area, 50%, 150% and 350%)

TruMap

(Overlap and background corrected mapping)

Calculated from SmartMap during or after acquisition

Available for SmartMap resolutions of 64, 128, 256, 512, 1024, 2048 and 4096 pixels (Montaged X-ray maps with resolutions up to 8192 pixels can be processed)

Order maps by max intensity, mean intensity, atomic number or alphabetically

Binning factors: 1, 2, 4, 8, 16 and 32

Discrete Colour scheme visualises variations in CPS

QuantMap

Calculated from SmartMap during or after acquisition

Available for SmartMap resolutions of 64, 128, 256, 512, 1024, 2048 and 4096 pixels (Montaged X-ray maps with resolutions up to 8192 pixels can be processed)

Order maps by max intensity, mean intensity, atomic number or alphabetically

Binning factors: 1, 2, 4, 8, 16 and 32

Map display in either Apparent Concentration, Wt%, At% or Oxide%

The 'Discrete' colour scheme enables the visualisation of quantitative variation in element concentration across all maps easily

TruLineScan

(Overlap and background corrected LineScanning)

Calculated from SmartLineScan during or after acquisition

Up to 8000 points allowed per line

Views (vertical tiles, stacked with normalised/unnormalised intensity and data table)

Calliper measurements available in each linescan viewer

Binning factors: 1, 2, 4, 8, 16 and 32

QuantLineScan

Calculated from SmartLineScan during or after acquisition

Full quantitative results available at each acquisition point

Up to 8000 points allowed per line

Views (vertical tiles, stacked with normalised/unnormalised intensity and data table)

Calliper measurements available in each linescan viewer

Binning factors: 1, 2, 4, 8, 16 and 32

LineScan display in either Apparent Concentration, Wt%, At% or Oxide%

AutoPhaseMap

Automatically creates maps of the distribution of phases in a specimen (during or after acquisition)

Available resolutions of 64, 128, 256, 512, 1024, 2048 and 4096 (and montaged datasets up to 8192)

PhaseMap, Spectrum and Area fraction shown for each detected phase

Phase Image showing all phases overlaid on electron image with colour key

LayerProbe

Navigator in **AZtec** to non-destructively measure the thickness and composition of surface and subsurface layers in thin film structures. Uses robust quantitative analysis routines available in **AZtec** and integrates them with powerful thin

film analysis engine for reliable results.

Non-destructive analysis with minimal sample preparation necessary

Predicts solvability and optimum experimental parameters to enable reliable, precise measurements

Analyses layers down to 1nm thickness*

Total structure thickness up to several microns possible*

Includes simulation tool to generate simulated X-ray spectra of thin film structures

*Precise limits are sample dependent and can be determined using the Solvability Tool supplied with the software

AZtecLAM (Large Area Mapping*)

Enables the unattended collection of high resolution electron images, and EDS / EBSD maps from large specimen areas, which can be 'stitched' together to create one overall

SmartMap dataset for further investigation within **AZtec**.

Up to 10,000 individual fields can be acquired in any one LAM run

Individual images up to 8Kx8K pixel resolution

Individual X-ray maps up to 4Kx4K pixel resolution

Pause and resume when filament blown

Automatic alignment of individual images and X-ray maps

Automatic brightness and contrast applied to all images

Montaged image or map data (EDS/EBSD) up to a maximum of 64 million pixels

MapQueue*

Enables the automatic acquisition of multiple image or mapping experiments. Individual mapping experiments on different areas of a specimen, or different specimens, from different stage locations can be queued up for automatic analysis.

Each mapping experiment can have different acquisition settings

Each acquisition can be an electron image or X-ray map, or both

Image Registration*

Functionality to register images for the purpose of specimen navigation and relocation

During an acquisition session on the microscope, any acquired image or map is automatically registered, enabling easy relocation to previously analysed areas

Any image can be used for navigation i.e. an X-ray map can be used to navigate to an area rich in a particular element

Manually registering images enables specific areas of a specimen to be further investigated at a later date, even on another microscope

** Requires microscope with external column and motorised stage control*

AZtecFeature

A high-performance particle analysis product for the fast and accurate detection, analysis and classification of particles, inclusions or features. Built on a dedicated AZtec navigator, it combines easy set-up with rapid and accurate particle detection and classification.

Analyse up to 200,000 particles and 10,000 fields per run

Compatible with up to 4 EDS detectors

Semi-automatic particle detection setup

Setup of thresholds for particle detection with real-time feedback on particles and morphological parameters detected

Detect particles from electron image or by chemistry from maps acquired from the whole field or triggered by grey level thresholds (FeaturePhase)

Gray level image processing options including median and smooth

Binary image processing options including open, close, dilate, erode, hole fill, particle separation

Tru-Q quality Auto-ID and quantification of X-ray data for every particle

Options to acquire X-ray data from each particle, extract X-ray data from a single field X-ray map or extract from a montaged large area map

Option to acquire X-ray data only on particles that meet certain morphological criteria

Option to acquire X-ray data in multiple stages, depending on the particle composition

Option to use multi-stage image acquisition for both accuracy and speed

SEM Stage automation to collect data from a large area on a single sample or over multiple samples

Option to automatically stitch and reconstruct particles spanning multiple fields of view

Option to visit fields in sequential or random order or in order of number of particles on the field (Survey Scan)

Option to terminate a run once a certain number or percentage of particles have been analysed or a certain amount of area has been analysed or a defined amount of time has elapsed

Particle classification based on chemistry, morphology, position, number of counts in EDS spectrum, gray level of feature in BSE image or a combination of the above - positive, negative and arithmetic criteria

Assisted classification setup

Histograms and tables for comprehensive data analysis with adjustable bin sizes

Two dimensional scatter plots

Quant Bars to graphically display and interrogate particle composition

Ternary diagrams of particle composition including oxide and sulfide plots

In-run monitoring of image brightness variations and automatic adjustment of thresholds

Data can be reprocessed and reclassified without the need for reacquisition

Relocation of a selected particle or field under the microscope beam for further investigation

Fully automated or manual re-acquisition of high resolution particle images from selected particles

Intuitive confirmation process for reacquired particles

Store and recall a setup (classification, thresholds, quantification, areas)

Store and recall single analysis areas or multiple area layouts for fast run setup

Reporting into MS-Excel and MS-Word.

AZtecSteel

A dedicated package developed specifically for the analysis and classification of speciality steels. The inclusions are detected, measured and analysed using **AZtecFeature** and the resulting data set is then processed using Inclusion Classifier. Inclusion Classifier is a software package designed to process steel inclusion data to the standard methods:

- ASTM E2142 (E45)
- ISO 4967
- GBT 30834
- ENV 10247
- Pirelli Method
- DIN 50602
- SIS 111116
- JIS G0555
- NFA 04-106

AZtecClean

AZtecClean is a dedicated package for Technical Cleanliness analysis according to ISO16232 / VDA 19.

It requires **AZtecFeature** and uses much of its functionality to calibrate the image contrast, set up analysis areas and automatically acquire data from samples containing particles collected from parts tested for component cleanliness. It also includes a recipe for **AZtecFeature** with suggested settings and step by step instructions - as well as a classification scheme and report template.

AZtecGSR

AZtecGSR is a dedicated package for Gunshot residue analysis according to ASTM E1588-16&17.

It uses much of the functionality included in **AZtecFeature** to calibrate the image contrast, set up analysis areas and automatically acquire data from suspected GSR particles and enable particle relocation to confirm their provenance. It also includes a recipe for **AZtecFeature** with suggested setting and a classification scheme suitable for Gunshot Residue analysis. An additional set of recipes are also included, based on Oxford Instruments' own work, which can give an indication of the brand of ammunition used. In addition to the software, **AZtecGSR** includes two standard samples. One is a Gold dot standard sample with Au particles of different sizes and a validation classification scheme to validate the particle detection capability of the system. It also includes an Image Calibration standard containing Carbon, Gold, Rhodium and Cobalt which is used to set the brightness and contrast on the SEM.



Available **AZtecLive** Packages and Options:

SDD Detector Options	Standard AZtecLive Package	Advanced AZtecLive Package	Automated AZtecLive Package
Ultim Max 40 mm ² , 65 mm ² , 100 mm ² or 170 mm ²	Option	Option	Option
Ultim Extreme	Option	Option	Option

AZtec Live			
AZtecLive Step	•	•	•
Analyser	•	•	•
Point&ID	•	•	•
Mapping	•	•	•
Linescan	•	•	•
Standardisation Manager	•	•	•
AutoLayer	•	•	•
TruMap (Mapping and LineScanning)	Option	•	•
AutoLock	Option	•	•
QuantMap (Mapping and Linescanning)	Option	•	•
AutoPhaseMap	Option	•	•
AZtecLAM	Option	Option	•
MapQueue	Option	Option	•
Image Registration	Option	Option	•
LayerProbe	Option	Option	Option
AZtecFeature	Option	Option	•
AZtecSteel	Option	Option	Option
AZtecClean	Option	Option	Option
AZtecGSR	Option	Option	Option

• included

www.oxford-instruments.com/AZtecLive

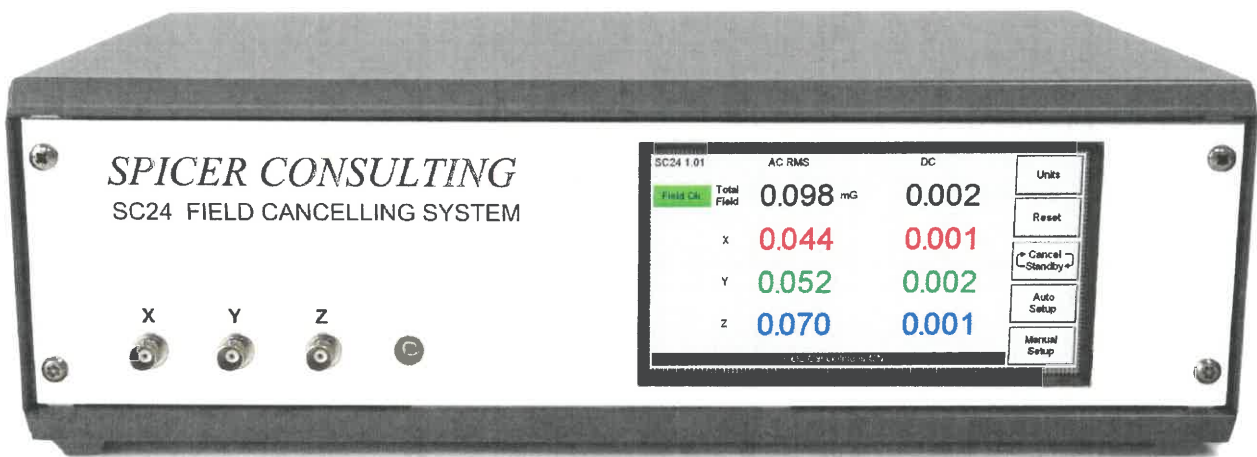
The materials presented here are summary in nature, subject to change, and intended for general information only. Performances are configuration dependent, and are based on AZtec Release 4.0. Additional details are available. Oxford Instruments NanoAnalysis is certified to ISO9001, ISO14001 and OHSAS 18001. AZtec, X-Max, Ultim and Tru-Q are Registered Trademarks of Oxford Instruments plc, all other trademarks acknowledged. © Oxford Instruments plc, 2017. All rights reserved. Document reference: Part no: OINA/AZtecLive/TDS/0817.



The Business of Science®



SC24 Magnetic Field Cancelling System



- **Makes the ambient magnetic field “OK” for the electron microscope**
- **Adapts to field changes within 100 μ s**
- **Touch screen intelligent user interface with automatic setup and DC reset**
- **Simultaneous AC & DC field display with choice of Tesla or Gauss units**
- **Mixes dual sensors to create virtual sensor “inside” the EM column**
- **Use AC sensors for cancelling 50/ 60 Hz AC line fields or:**
- **Use DC sensors for cancelling tram and train DC fields and 50/60Hz**
- **Built-in test field generator**
- **Ethernet and USB ports for remote operation and monitoring**

Overview

Electron microscopes have to operate in an ambient magnetic field comprising the earth’s field and fields radiated by electric power networks and electrical machines.

When the ambient field changes, the electron beam in the microscope is deflected, causing loss of resolution and image distortion. The SC24 system stabilises the field by dynamically creating nearly equal and opposite field changes, so microscope performance is much improved.

The SC24 system comprises a magnetic field control unit, one or two magnetic field sensors and three orthogonal axis multicore cables, that are installed in the room where the field is to be cancelled.

Three power amplifiers in the control unit drive currents through the cables to create a field of the opposite sign to the change in ambient field.

The magnetic field sensor measures the resulting field and real time negative feedback reduces the ambient field by the loop gain of the system.

The system is dynamic, automatically responding to field changes within 100 μ s.

Product Description

The SC24 is a fourth generation Magnetic Field Cancelling System, designed to improve the performance of electronic instruments which are sensitive to magnetic fields, such as electron microscopes and electron beam metrology tools.

The SC24 is an enhanced replacement for the SC20 system, which has an installed base of over 400 units world wide.

The field cancelling method is wide band analog negative feedback. An embedded microcomputer controls the system and digitises the fields for measurement but is not within the feedback loop.

Options for installation of the SC24 cables in the microscope room are shown on page 3.

The SC24 can use one or two AC sensors or one or two wideband DC sensors. Wideband DC sensors are only necessary when the ambient has bad DC fields, typically from DC powered trams or trains. The AC sensors are lower cost and slightly easier to use.

Typically for SEMs one magnetic field sensor is used, located near the bottom of the electron beam column. Typically for TEMs two sensors are used spaced about 300mm from either side of the electron beam column at the sample stage height.

The SC24 system does not cancel the field everywhere in the room. It creates a region around the magnetic field sensors where the field is much reduced. The volume of this region depends on the uniformity of the ambient field and the design of the field cables.

The SC24 user interface is a touch screen LCD display panel shown below. This is a typical display for an SC24 with one or two wideband DC sensors when the system is cancelling and the field is OK.

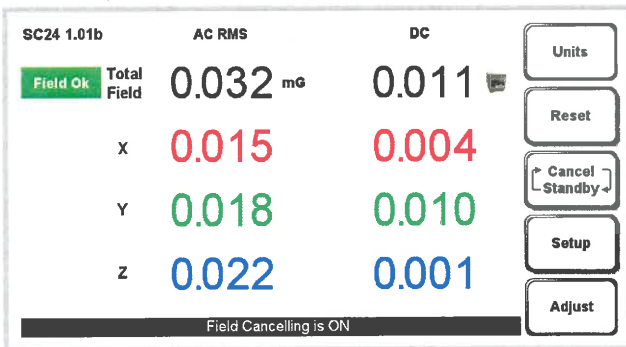


Fig. 1. Typical touch screen display

The five buttons control operation of the system.

The “units” button calls up the units sub menu to select RMS or pk-pk, Tesla or Gauss units. The choice of units has no effect on cancelling.

The reset button clears the “trip” indicators and resets the “zero field” operating point of the DC sensors.

The “cancel/standby” button turns cancelling on and off.

Magnetic field amplitudes are displayed with 100pT (1.0 μ Gauss) resolution. The DC field amplitudes are not displayed for AC sensors.

The magnetic field amplitudes are continuously monitored and compared with preset trip levels to provide “Field OK” indication.

The SC24 has “one button” automatic setup. On setup it analyses the installation, reports installation problems and sets up the feedback loop gain and phase. All setup parameters are stored in non-volatile memory on power loss and on subsequent power up it re-tests the installation. If it find no changes it resumes operation in the pre-power loss state, otherwise it requests setup.

The “adjust” button enables entry to the adjustment menu (for expert users), typical display in Fig. 2. It also gives the option to “lock” the touch screen and reset the Ethernet password. When the screen is “locked” the five buttons are replaced by a new button that allows unlocking if pressed for five seconds.

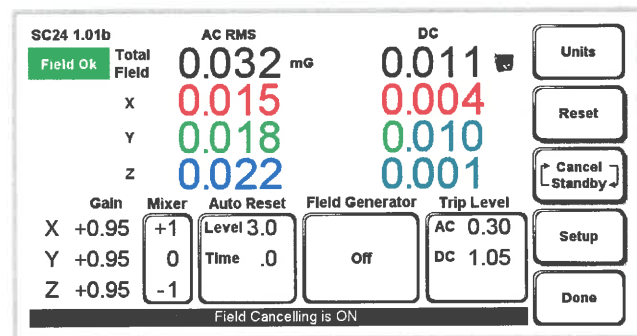


Fig. 2. Adjustment menu

The “Mixer”, “Auto Reset”, “Field Generator” and “Trip Level” touch buttons control the adjustments, described in the **Adjustment Details** section later.

Product Installation

The design of the cable installation in the microscope room involves a trade-off between cost, complexity and performance.

Figs. 3, 4 & 5 show the main design types. Fig 3. is the design with the best performance that is recommended for large TEMs and for all new-build microscope labs.

The dimensions of the dual loop cables have been optimised to make the cable fields uniform over the length of the microscope column for this size room. The SC24 specification refers to an installation with these dimensions.

We usually supply optimised custom sized cables to fit the customer’s rooms. The SC24 can only be used with cables supplied by Spicer Consulting.

In Fig. 3, the multi-core cables each make one turn and are shown in red, green and blue. The actual cables are black or grey and usually installed in white plastic conduits. Where the room has a false ceiling, parts of the cables may be installed above it.

In Fig. 3 the lower parts of the X & Y cables are shown buried below the floor. This is practical for new-build labs. Parts of the bottom Z cable also need to be buried at door openings. Burying the X & Y cables below the floor is recommended for a TEM with a Gatan Imaging Filter for good cancelling at GIF height.

Room Installation options

Fig. 3. Installation for TEMs and new Lab Builds

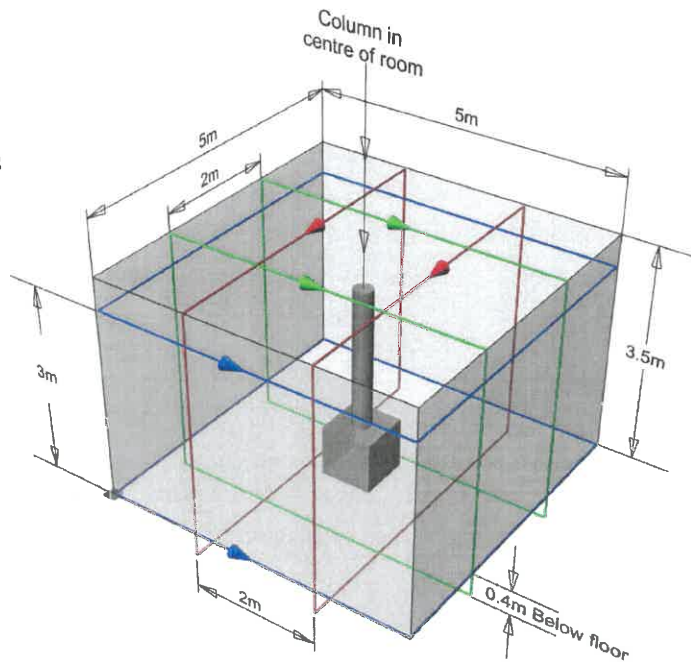


Fig. 4. Basic Installation for TEMs and SEMs

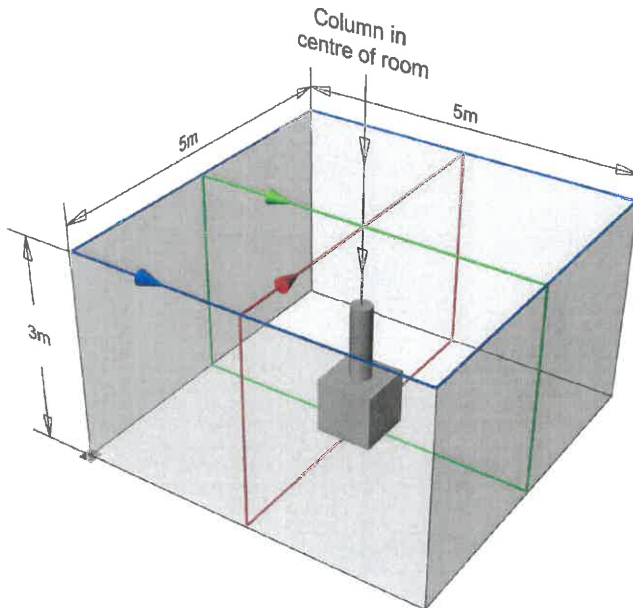
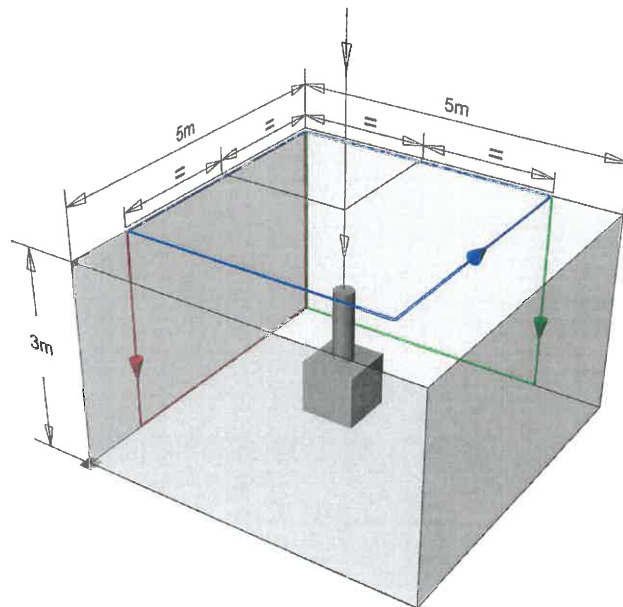


Fig. 5. Minimal Installation for SEMs



Notes:

- X cable loops: RED
- Y cable loops: GREEN
- Z cable loops: BLUE

For existing microscope installations where burying cables is not an option, the bottom sections of the cables can be at floor level and covered with suitable cable protectors. The X and Y cancelling performance at GIF height will be compromised.

Fig. 4 shows the second best cable installation. It has been used with Spicer Consulting Cancelling systems since the SC07 model was launched in 1991. It works best if the X & Y cables cross over directly above the microscope column. It requires cables on the floor covered with suitable cable protectors.

Fig 5. is the simplest, lowest cost installation. It usually does not require cables on the floor. The dynamic range and the cancelled volume are smaller because the cables are farther from the column. This installation makes larger fields in the adjacent rooms which may not be acceptable.

There are many Fig. 5 installations on Scanning Electron Microscopes. SEMs. have small columns so can tolerate the small cancelled volume. Their installations are typically “tuned” by adjusting the sensor position to find the sweet spot for best image improvement.

Sensors and mounts

Standard sensor mounts are shown below.



Fig.6
Sensor SC24/AC



Fig.7
Sensor SC24/DC+AC

With “Sensor SC24/AC” the SC24 provides useful cancelling from 2.5Hz to 5kHz. The ratio of the ambient field to the cancelled field is called the cancelling factor. It is a function of frequency and is greater than 50 at 60Hz. (Fig. 8)

With “Sensor SC24/DC+AC” the SC24 provides useful cancelling from DC to 5kHz. The cancelling factor is greater than 400 at DC and 100 at 60Hz.

“Sensor SC24/DC+AC” contains small Helmholtz coils that surround its field sensing elements. They are used to offset the DC component of the ambient field including the earths field. At reset, the microcomputer in the sensor adjusts and remembers the currents in the coils to set the X, Y, Z sensor outputs to zero. The reset process takes 1 second. The sensor must be reset if it is moved.

The SC24 has two sensor inputs. It can work with one or two sensors. They must be the same type, AC or DC. The SC24 detects the sensor type to choose the correct filters in the cancelling feedback loop. If different types are plugged in, the SC24 reports a sensor error.

When there are two sensors the SC24 enables the mixer function. The two sensors are placed either side of the microscope column. The “mixed field” is a weighted combination of the sensor outputs, creating an adjustable “virtual sensor” between the two sensors.

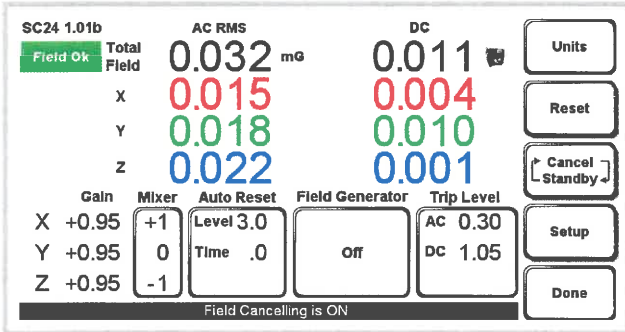
The mixer is adjusted by observing the microscope image and tuning for best image improvement. The mixed fields are displayed on the SC24 screen.

When an electron microscope changes magnification or imaging mode its magnetic lenses may create large DC changes in the ambient field that can overload the cancelling system. With two sensors that can be spaced away from the column the overload is less.

“Sensor SC24/AC” adjusts to the new DC level automatically but the transient may overload it for several seconds. There may be image position drift until the sensor adjusts.

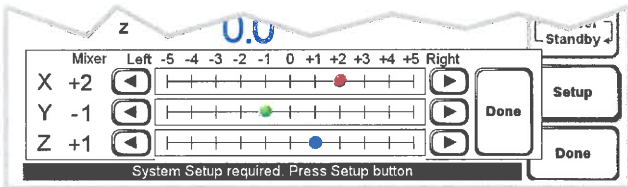
“Sensor SC24/DC+AC” responds to DC so a change in DC field that overloads the cancelling system requires a sensor reset to restart operation at the new ambient field level. The SC24 has an “Auto Reset” function, see the adjustment details section.

Adjustment details



“Setup” automatically sets the feedback loop gains and phases. The gain values are displayed for reference. There is no manual adjustment.

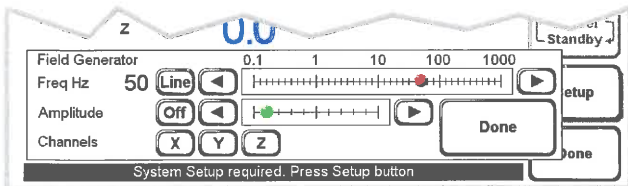
The “mixer” button opens a sub-screen with sliders to adjust the mixers, shown below. Run “setup” after adjusting the mixers (recommended).



The “Trip Level” button enables trip setting adjustment between 10nT and 200nT. The default trip levels are 25nT RMS (AC) and 100nT DC. The trip level has no effect on cancelling.

The SC24 has a built-in field generator that makes test fields using the cancelling cables. It uses the field generator during “setup” to measure the strength of the cancelling cables and determine the correct loop gain and phase.

The field generator can be used to make fields and test the sensitivity of the microscope to those fields. The fields can be sine wave at line frequency or square wave at the frequency selected using the sliders below. Square waves are low pass filtered at 1.6kHz. The test field can be connected to the selected axes.



Outside the adjustment screen the field generator is set to OFF. Inside the adjustment screen, it is possible to have field generation and field cancelling at the same time (for experts only).

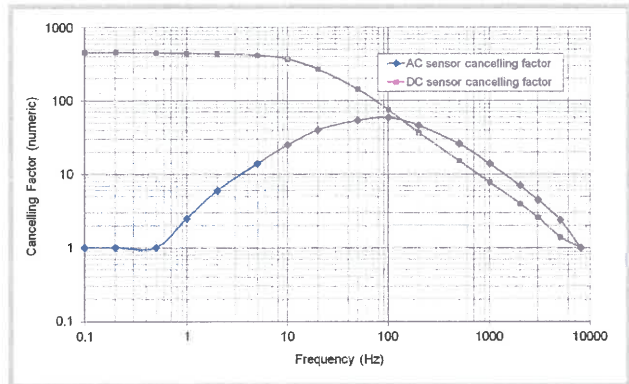
The “Auto Reset” button enables and disables auto reset and sets its sensitivity. When enabled, a small sensor icon appears on the main display (near the “units” button, Fig 1.)

Auto reset only happens when the SC24 is cancelling. It is triggered from the DC field level, which is usually near zero because the DC cancelling factor is large. During overload, the measured field rises abruptly, triggering auto reset.

To prevent nuisance resets “Auto Reset” delays before it resets the DC sensor. The overload field and time delay can be set. The defaults are 500nT and 5 seconds.

Cancelling Factor

The “cancelling factor” is the ratio of the ambient field to the cancelled field. A Graph of cancelling factor vs. frequency is below.



Networking

The SC24 has USB and Ethernet ports.

Software for installation on the customers computer network is in development and will be available shortly.

The software features will include operation of the SC24 over the network and long term recording of the system status and fields.

Specifications

UNITS

Gauss, Tesla, selectable

FIELD CANCELLING

Co-ordinates	X, Y, Z rectangular Cartesian
Components cancelled	X, Y, Z fields
Measurement range (X & Y) ^{NOTE 1}	4.8 μ T pk-pk (installation Fig. 3)
Measurement range (Z) ^{NOTE 1}	3.3 μ T pk-pk (installation Fig. 3)

1. With Sensor SC24/AC

Field cancelling factor	> 50 X at 50/60 Hz
Bandwidth	2.5 Hz - 5000 Hz
Cancelling noise limit (0.5 to 5000Hz)	0.6 nT RMS total

2. With Sensor SC24/DC+AC

Ambient DC field limit	\pm 200 μ T max
Field cancelling factor	> 100 X at 50/60 Hz > 400 X at DC (incremental)
Bandwidth	DC - 5000 Hz
Cancelling noise limit (DC to 5000Hz)	0.7 nT RMS total
DC drift ^{NOTE 3}	< 2 nT/ 24 hours

FIELD MEASUREMENT

Types

Real time field
AC RMS and pk-pk
DC incremental (Sensor SC24/DC+AC)

Display

LCD touch screen	See product description
Sensor dynamic range	4.2 μ T pk-pk
Accuracy ^{NOTE 2}	\pm 1.0 % of reading \pm 1 nT

X, Y, Z real time field outputs

Scaling	10 V/ μ T (1.0V/mG)
Range	\pm 12 Volts
Source resistance	10 k Ω
Connectors	3 x BNC
Bandwidth	25 Hz - 10 kHz (Sensor SC24/AC) DC - 10 kHz (Sensor SC24/DC+AC)

TEST FIELD GENERATOR

Sine wave	AC line frequency (50/60Hz) - line locked
Square wave	0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100, 200, 500, 1000, Hz

POWER

120/240 V 50/60 Hz, 100 VA

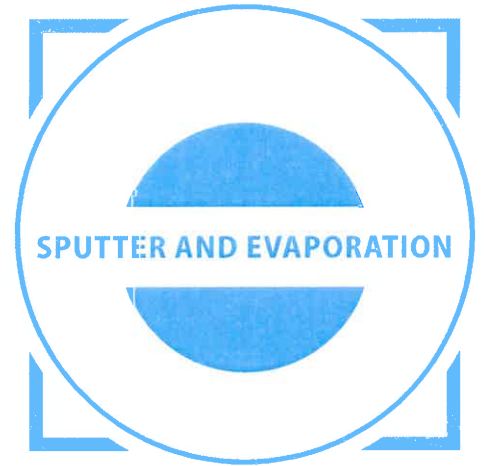
Note 1: Measurement range is stated with standard cancelling cables.
Larger range is available for extreme fields with custom cables.
Measurement range is stated at the nominal AC power input of 120 or 240 volts RMS
De-rate linearly for lower voltages

Note 2: Sensors are calibrated with 50 Hz, 1 μ T RMS square wave field.

Note 3: Drift (@23°C \pm 2°C, after 2 hour warm-up)

Q150R PLUS

Rotary Pumped Coater



The Q150R Plus is suitable for use with Tungsten/LaB₆ SEM and Benchtop SEM.

Sputter coating of noble metals using the Q150R S & ES Plus:

Recommended for magnifications:

- up to x 50k using Au, Au/Pd
- up to x 100k using Pt (optional)

Carbon cord coating for elemental analysis using the Q150R E & ES Plus.

Recommended applications:

- Low and medium magnifications
- SE signal boost (1nm or less)
- Table-top SEM coating
- Elemental analysis
- Copper metallisation layers

Q150R Plus features

New user interface has been thoroughly updated:

- **Capacitive touch screen is more sensitive for ease of use**
- **User interface software has been extensively revised, using a modern smartphone-style interface**
- **Comprehensive context-sensitive help screen**
- **USB interface allows easy software updates and backing up/copying of recipe files to USB stick**
- **Process log files can be exported via USB port in .csv format for analysis in Excel or similar. Log**

files include date, time and process parameters.

- **16GB of flash memory can store more than 1000 recipes**
- **Dual-core ARM processor for a fast, responsive display**

Allows multiple users to input and store coating recipes, with a new feature to sort recipes per user according to recent use.

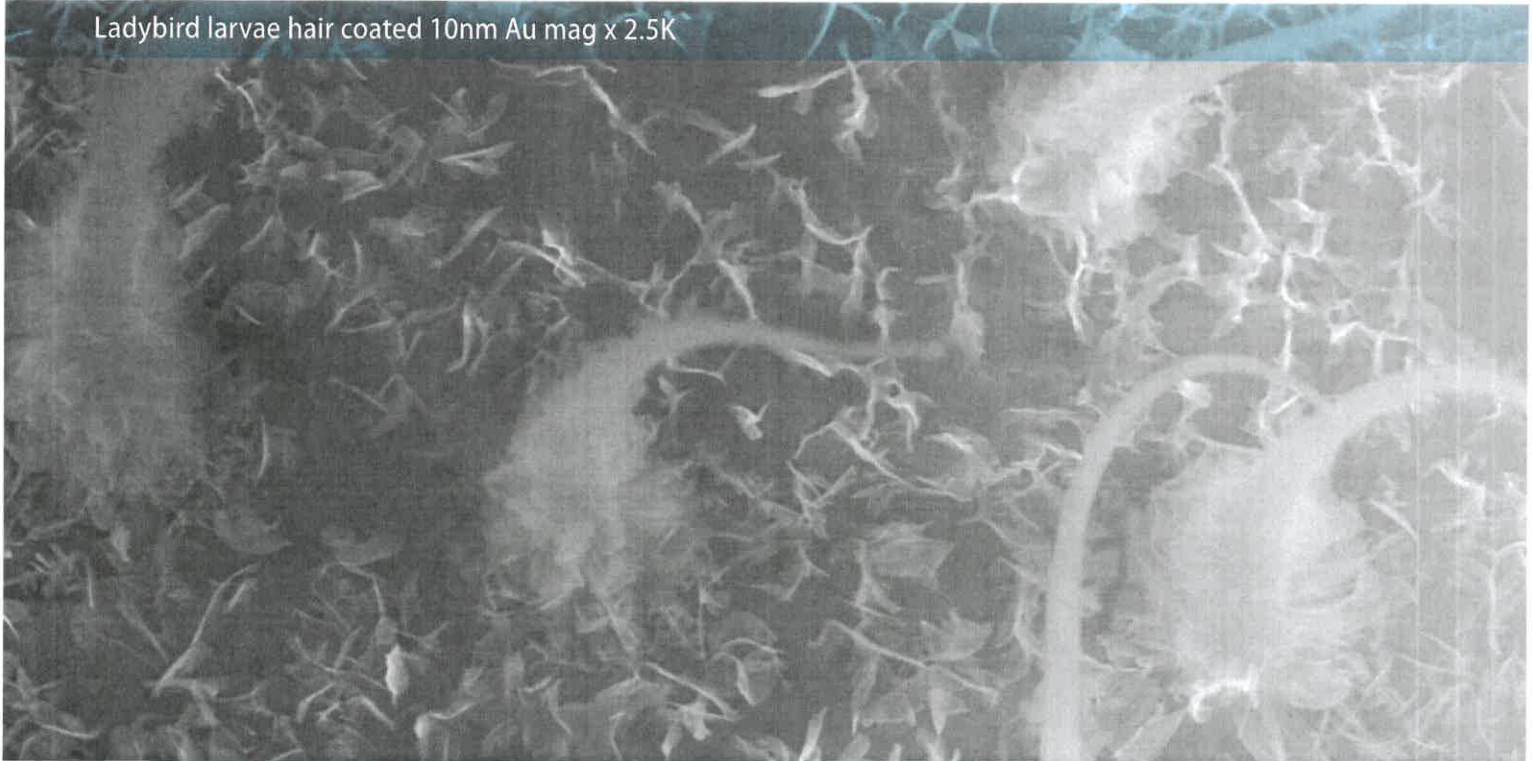
Intelligent system logic automatically detects which insert is in place and displays the appropriate operating settings and controls for that process.

System prompts user to confirm target material and it then automatically selects appropriate parameters for that material.

Intuitive software allows the most inexperienced or occasional operator to rapidly enter and store their own process data. For convenience a number of typical sputtering and carbon coating profiles are already stored but also allows the user to create their own.

Software detects failure to achieve vacuum in a set period of time and shuts down the process in case of vacuum leak, which ensures pump protection from overheating.

Ladybird larvae hair coated 10nm Au mag x 2.5K



The Q150R Plus is available in three configurations:

Q150R S PLUS

An automatic sputter coater for non-oxidising metals

Available sputtering targets including gold, gold-palladium and platinum.



Q150R E PLUS

An automatic carbon cord coater for SEM applications such as EDS and WDS.



Q150R ES PLUS

A combined system capable of both sputtering and carbon coating

The deposition head inserts can be swapped in seconds.



The Q150R Plus is part of Quorum Technologies internationally acclaimed Q series of coaters, used by thousands of customers worldwide. Designed to provide high-quality coating solutions for SEM, TEM and thin-film applications, the Q series is versatile, affordable and easy to use. **These products are for Research Use Only.**

Automatic, controlled pulsed carbon cord evaporation

The carbon evaporation process can be terminated using the optional film thickness monitor, which incorporates a quartz crystal monitor, fitted as standard on E and ES models. This recipe ensures that carbon is evaporated in short controlled pulses, which has two effects; protecting the sample from heating and ensuring the accuracy of the film thickness monitor. Pulsing also significantly reduces the amount of debris (including large carbon fragments) associated with traditional carbon "flash" evaporation. Pulsed and ramped carbon rod recipes are supplied as standard.

Cool Magnetron Sputtering

Sputter coating is a technique widely used in various applications; it is possible to create a plasma and sputter metals with high voltage, poor vacuum and no automation. However, this is not suitable for electron microscopy applications because it will heat the sample and can result in damage when the plasma interacts with the sample. The Q series uses low temperature enhanced-plasma magnetrons optimised for the rotary pump pressures, combined with low current and deposition control, which ensures your sample is protected and uniformly coated.

The Q150R S Plus and Q150R ES Plus use easy-change, 57 mm diameter, disc-style targets which are designed to sputter non-oxidising (noble) metals – ideal for W-SEM applications. The Q150R S Plus and Q150R ES Plus are fitted as standard with a gold (Au) sputter target.

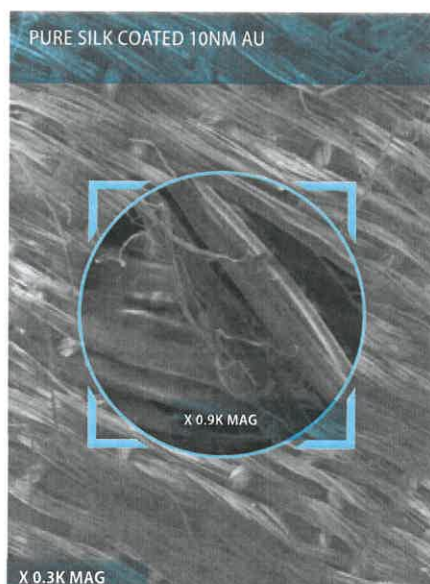
Other targets options include; Au/Pd, Pt/Pd, Pd, and Cu. Platinum (Pt) can also be sputtered with the optional Pt coating vacuum hose assembly.



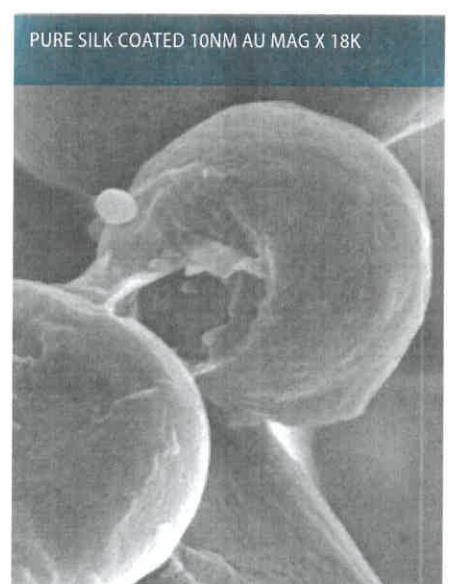
Q150R Plus comparative performance:



Textiles charge extensively when subjected to electron beam, this results in artefacts in images.



Coating with Au improves contrast, prevents charging and emerging artefacts.



Despite the coating, the impurities on the silk fibres are clearly visible.

Q150R Plus features

Interchangeable plug-in heads

This allows the user to configure the system as a sputter coater, evaporator or glow discharge system - all in one space saving format. A carbon cord evaporation insert is available as an option. Automatic detection of the head type when changed.

Detachable chamber with built-in implosion guard

Removable glass chamber and easily accessible base and top plate allows for an easy cleaning process.

Users can rapidly change the chamber, if necessary, to avoid cross contamination of sensitive samples.

Tall chamber option is available for carbon evaporation to avoid sample heating, to improve uniformity for sputtering and to hold taller samples.

Multiple stage options

The Q150R Plus has specimen stages to meet most requirements. All are easy-change, drop-in style (no screws) and are height adjustable (except for the rotary planetary stage). Some examples:

- **Rotation stage (supplied as standard):** 50 mm Ø can accommodate six standard stubs. Height can be pre-set.
- **Rotate-tilt stage for improved uniform coating:** 50 mm Ø. Tilt and height can be pre-set.
- **Variable angle, rotary planetary stage for heavily contoured samples**
- **Large flat rotation stage with offset gear box for 4"/100 mm wafers**
- **Rotation stage for glass microscope slides**

Other options are available on request.

Safety

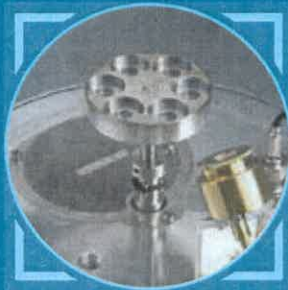
The Q150R Plus meets key industry CE standards

- **All electronic components are protected by covers**
- **Implosion guard prevents user injury in event of chamber failure**
- **Vacuum interlocks remove power from deposition sources to prevent user exposure to high voltage in event of chamber being opened**
- **Electrical interlocks remove power when source head cover opened**
- **Overheating protection shuts down power supply**

Examples of stages, shown with optional FTM



Microscope slide stage



Rotation stage



Wafer stage



Rotary planetary stage

Specifications

Instrument case

585 mm W x 470 mm D x 410 mm H
(total height with coating head open: 650 mm)

Weight

28.4 kg (packed: 42 kg)

Packed dimensions

725 mm W x 660 mm D x 680 mm H

Work chamber

Borosilicate glass 150 mm ID x 127 mm H

Display

115.5 mm W x 86.4 mm H (active area), 640 RGB x 480 (display format), capacitive touch colour display

User interface

Full graphical interface with touch screen buttons, includes features such as a log of the last 1000 coatings and reminders for when maintenance is due

Sputter target

Disc-style 57 mm Ø 0.1 mm thick gold (Au) target is fitted as standard. R S and R ES versions only

Specimen stage

50 mm Ø rotation stage with rotation speed of 8-20 rpm.
Other stages available on request.

Vacuum

Rotary pump: optional 5 m³/hr two-stage rotary pump with oil mist filter (order separately)

Vacuum measurement: Pirani gauge

Ultimate vacuum: 2 x 10⁻⁵ mbar*

Sputter vacuum range: Between 7 x 10⁻³ and 1 x 10⁻¹ mbar for gold

**Typical ultimate vacuum of the pumping system in a clean instrument after pre-pumping with dry nitrogen gas*

Processes

Sputtering: Sputter current 0-80 mA to a predetermined thickness (with optional FTM) or by the built-in timer. The maximum sputtering time is 60 minutes (without breaking vacuum and with automatically built-in cooling periods)

Carbon evaporation: A robust, ripple free DC power supply featuring pulse evaporation ensures reproducible carbon evaporation from cord sources. Current pulse: 1-70 A current.

Visual status indicator

A large multi-colour status indicator light provides a visual indication of the state of the equipment, allowing users to easily identify the status of a process at a distance.

The indicator LED shows the following states:

- Initialisation
- Process running
- Idle
- Coating in progress
- Process completed
- Process ended in fault condition

Audio indication also sounds on completion of the process.

STATEMENT

23rd July, 2019

To whom it may concern:

This is the confirmation of TESCAN scanning electron microscope model MIRA3 resolution parameters.

This type of microscope can achieve resolution values which are equal or better to the values written in official specification sheet. Such statement can be validated during acceptance procedure in Tescan Brno factory.

Sincerely,



Michal Hadinec

Product Specialist

TESCAN Brno, s.r.o., Libušina tř. 816/1, 623 00 Brno, Czech Republic

Phone: +420 530 353 451

E-mail: michal.hadinec@tescan.com, <http://www.tescan.com>

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STATEMENT

29th July, 2019

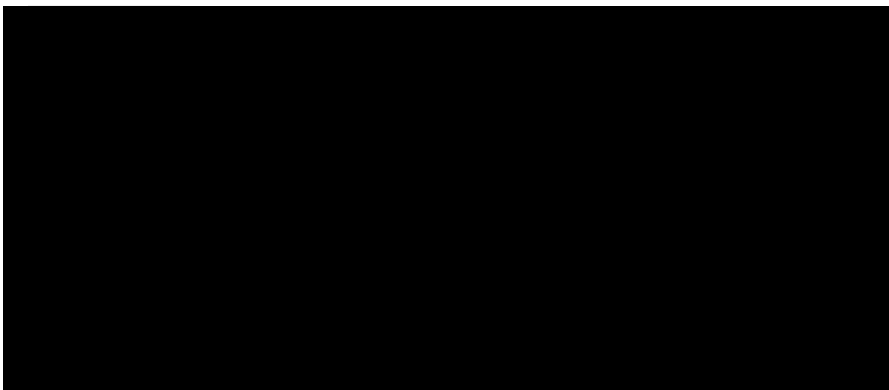
To whom it may concern:

This is the confirmation of TESCAN scanning electron microscope model MIRA3 resolution parameters.

In case of Technology of negative potential applied to the stage in order to improve the resolution at low accelerating voltages: Resolution better than 1,8 nm @ 1 kV, observation of magnetic samples.

In case of imaging using the detector of transmitted electrons: Resolution better than 0,8 nm @ 30 kV (transmitted electrons).

Sincerely,



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Explanation and supplementing of data in the bid

Contracting authority:

**Institute of Physics of the Czech Academy of Sciences,
public research institution**

Registered Office: Na Slovance 2, 182 21 Prague 8, Czech Republic

Identification No.: 683 78 271

Person authorised to act on behalf of the Contracting authority: RNDr. Michael Prouza, Ph.D., Director

Representative of the Contracting authority pursuant to Section 43 of the Act:

Advokátní kancelář Volopich, Tomšíček & spol., s.r.o., registered in the Commercial Register kept by Regional Court in Plzeň, Section C, File 29293, with its registered office at Vlastina 602/23, Severní Předměstí, 323 00 Plzeň, Id. No. 024 76 649

Public contract:

Scanning Electron Microscope (SEM) and its accessories

Dear JUDr. Tomšíček,

On the base of request for explanation or supplementing of data in the bid we assume the completion of the data required in points A – M.

- A) Specification of the High Resolution Schottky FE-SEM submitted in our bid is a general technical specification of FE-SEM MIRA3 LMH contains all technical detail of system and complete standard and optional features for this FE-SEM.

In-Beam SE Detector for inside-the-column detection of electrons at short working distances

Beam Deceleration Technology (BDT) for excellent resolution at low beam voltages

In-Beam BSE Detector for BSE imaging at very short working distances

TESCAN Brno, s.r.o. confirms that offered equipment contain all the listed parts defined at bid document 7_Annex no. 1 - TechnicalSpecification

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- B) Specification of the High Resolution Schottky FE-SEM submitted in our bid is a general technical specification of FE-SEM MIRA3 LMH contains all technical detail of system and complete standard and optional features for this FE-SEM.

Resolution - BD mode

STEM detector – offered system include a retractable HADF

In-Beam BSE

TESCAN Brno, s.r.o. confirms that these accessories are part of the offered system.

- C) Specification of the High Resolution Schottky FE-SEM submitted in our bid is a general technical specification of FE-SEM MIRA3 LMH contains all technical detail of system and complete standard and optional features for this FE-SEM.

Active vibration isolation (integrated)

TESCAN Brno, s.r.o. confirms that this feature is part of the offered system.

- D) Specification of the High Resolution Schottky FE-SEM submitted in our bid is a general technical specification of FE-SEM MIRA3 LMH contains all technical detail of system and complete standard and optional features for this FE-SEM.

In-Beam BSE

In-Beam LE-BSE

LE-BSE

TESCAN Brno, s.r.o. confirms that these detectors are part of the offered system.

- E) Specification of the High Resolution Schottky FE-SEM submitted in our bid is a general technical specification of FE-SEM MIRA3 LMH contains all technical detail of system and complete standard and optional features for this FE-SEM.

Control Panel

Plasma Cleaner (Decontaminator)

TESCAN Brno, s.r.o. confirms that these accessories are part of the offered system.

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- F) Specification of the High Resolution Schottky FE-SEM submitted in our bid is a general technical specification of FE-SEM MIRA3 LMH contains all technical detail of system and complete standard and optional features for this FE-SEM.

PC High Performance include 2x SSD 250 GB each

TESCAN Brno, s.r.o. confirms that parameters of this features are part of the offered PC unit.

- G) Technical Specification of Scanning Electron Microscope (SEM) and its accessories in his bid containing in table 4 following: *“The complete integration of both EDS detectors and their full control and ensuring functionality within one software interface is required.”*

TESCAN Brno, s.r.o. confirms that both EDS detectors are a fully controlled within one software.

- H) Technical Specification of Scanning Electron Microscope (SEM) and its accessories in his bid containing in table 6 following: *“Vacuum components necessary for operation must be part of delivery and installed by supplier.”*

TESCAN Brno, s.r.o. confirms that vacuum components (Dry Scoll for vacuum pump and Turbo molecular HiVacuum Pump) necessary for operation are part of delivery and installed by supplier.

- I) Technical Specification of Scanning Electron Microscope (SEM) and its accessories in his bid containing in table 7 following: *“The solid frames holding the wiring meant to produce the cancellation fields must be supplied and their construction adapted to ensure sufficient field cancelation inside the shielded space.”*

TESCAN Brno, s.r.o. confirms that solid frames (System SC 24 from Spicer Consulting) holding the wiring meant to produce the cancellation fields will be supplied and their construction adapted to ensure sufficient field cancelation inside the shielded space.

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- J) Technical Specification of Scanning Electron Microscope (SEM) and its accessories in his bid containing in table 9 following: “Similar parts must be available to replace at least five years after the date the microscope has been purchased.”

TESCAN Brno, s.r.o. confirms that Similar parts will be available to replace at least five years after the date of microscope installation.

- K) Technical specification folder of Q150R PLUS Rotary Pumped Coater containing on the last page “Q150R Plus features” two types of pressure – Ultimate vacuum and Sputter vacuum range.

TESCAN Brno, s.r.o. confirms that sputter coater will be provided with vacuum level corresponding to residual pressure of 2×10^{-2} mbar or less.

- L) **TESCAN Brno, s.r.o. confirms that EDS detector 1 that Participant specify in his bid in table 3 of technical specification as Ultim Max Extreme is identical to EDS detector Ultim Extreme described in prospectus (OXFORD INSTRUMENTS) on page 43 of bid.**

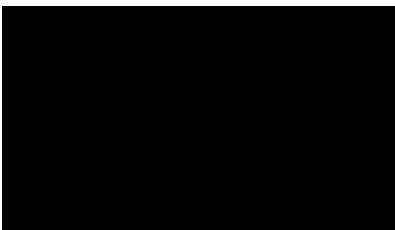
- M) With reference to Participant’s confirmation dated 23rd July 2019 we would like to ask Participant to clarify and confirm, that fulfilment of required parameters (see our request dated on 17.7.2019) will be verified during setup and installation including direct measurements at the place of delivery, as stipulated under Art. 1.2 of the purchase contract.

TESCAN Brno s.r.o. confirms in accordance of Statement dated 23rd July 2019 fulfilment of required parameters of resolution values which are equal or better to the values written in official specification sheet. These parameters will be validated during testing procedure in TESCAN Brno factory where the environmental conditions defined in the technical specification of system are reached.

These parameters will be validated also within acceptance procedure during installation on site of delivery. Reaching environmental conditions of delivery place according to technical specifications of system is solely responsibility of buyer.

An integral part of the delivery are the solid frames (System SC 24 from Spicer Consulting) holding the wiring meant to produce the cancellation fields. Its construction is adapted to ensure sufficient field cancellation inside the shielded space.

If specified conditions of ELMG fields are reached on site of delivery using Spicer SC 24 then we are able to fulfil the required parameters.



Brno, on 9/10/2019

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Explanation and supplementing of data in the bid

Contracting authority:

**Institute of Physics of the Czech Academy of Sciences,
public research institution**

Registered Office: Na Slovance 2,182 21 Prague 8, Czech Republic

Identification No.: 683 78 271

Person authorised to act on behalf of the Contracting authority: RNDr. Michael Prouza, Ph.D., Director

Representative of the Contracting authority pursuant to Section 43 of the Act:

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Public contract:

Scanning Electron Microscope (SEM) and its accessories

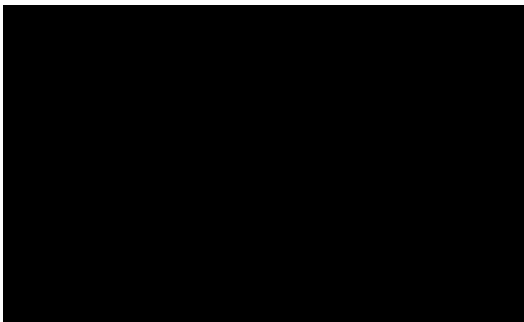
Dear JUDr. Tomšíček,

On the base of request No.4 from October 21st, 2019 for explanation or supplementing of data in the bid we assume the completion of requested data.

A) Participant states in his explanation from 9/10/2019 that parameters of resolution values are equal or better to the values written in official specification sheet and in his explanation from 29/7/2019 states following information:

*„In case of Technology of negative potential applied to the stage in order to improve the resolution at low accelerating voltages: Resolution better than 1,8 nm @ 1 kV, observation of magnetic samples.
In case of imaging using the detector of transmitted electrons: Resolution better than 0,8 nm @ 30 kV (transmitted electrons).“*

TESCAN Brno, s.r.o. confirms that information in the Participant's explanation from 29/7/2019 is valid.



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