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From: Director, CSIR-NPL
Ref No. 14-VIII/SSK(27-GTE)2024PB/T-242 Dated : 21.03.2025

CORRIGENDUM

With reference to NPL's Global Tender ID: **2025_CSIR_790564_1**, A Pre-Bid Conference (PBC) was concluded on 18.03.2025 for the procurement of "Electron Beam Lithography". Consequent upon the outcome of PBC, **some changes have been made in the technical specification of captioned tender. Revised specifications are as follows:**

Annexure-1: Final Technical specification of "Electron Beam Lithography (EBL) system after PBC meeting"

Scope of supply: Electron beam lithography (EBL) system should align and expose various layers on a ≤ 100 mm wafer with a minimum feature size of ≤ 10 nm and a writing field of ≥ 1000 µm.

1. Electron source:

1.1. Thermal field emission Schottky source is needed for long-term stability, low noise and a typical lifetime of 5000 hours or more.

1.2. Fully digital electron optics column, acceleration voltage ≥ 30 kV, routinely useable.

1.3. The e-beam current to the samples should be ≤ 100 pA to 10 nA or more.

1.4. Appropriate apertures should be provided to control the current.

1.5. Column pressure at the gun should be ≤ 5E-6 Pa and should include adequate isolation and interlock features to avoid lasting gun damage.

2. Electron Optics system:

2.1. Beam position stability: ≤ 300 nm/hr at ambient with fluctuation of ± 0.5 °C.

2.2. Beam current stability ≤ 1% over 4 hrs or larger time at ambient with fluctuation of ± 0.5 °C.

2.3. Beam spot size: ≤2 nm.

2.4. The beam blanking speed should be compatible with with the maximum writing speed of pattern generator the system,.

3. Lithography resolution:

3.1. The system should be capable of writing a minimum feature size of 10 nm or less.

3.2. The end system should be capable to expose grating patterns with a linewidth of ≤ 40 nm.

3.3. The system should have the largest writing field of 1000 µm or more.

3.4. Overlay accuracy should be ≤ 40nm (mean+3sigma).

3.5. Field stitching: ≤ 50 nm

4. Specimen stage and sample holder:

4.1. The movement of the stage should be controllable by external hardware or using the control software of the system, by scripting, and by pointing to the scanned images.

4.2. A 100 × 100 mm travel range laser interferometer controlled stage for X-Y positioning and 5 mm for Z direction.

4.3. The resolution for X and Y movement of the laser interferometric stage should be ≤ 1 nm.

4.4. The sample holder should be able to accommodate wafers of size 2", 3" and 4" as well as rectangular/square samples of size ≤ 10 mm × 10 mm.

5. Main chamber and load lock:

5.1. Main chamber should be able to accommodate the above-mentioned specimen stage.

5.2. Main Chamber should be able to pump down to pressure ≤ 5E-3 Pa

5.3. If the operation of the system requires a CCD camera in the main chamber, the same should be provided by the vendor.

5.4. The main chamber should have adequate safety interlocks/alarms.

5.5. Load lock option for automatic/manual substrate pickup holder into the process chamber.

5.6. System should be equipped with dry vacuum pumps for oil-free system vacuum.

5.7. Both load lock as well as main chamber should have proper suitable full-range vacuum gauges.

5.8. The control software of the system should have the provision of display of the vacuum levels of the system

6. Pattern generator and design software:

6.1. Should be able to write patterns with speed of ≥ 20 MHz. All base primitives should be available (e.g. circle, rectangle, triangle, polygon). System should also have provision of exposing the patterns using raster as well as vector scans.

6.2. The system should have mechanism for astigmatism and focus correction.

6.3. The user should be able to adjust the mark locate algorithm's contrast and brightness settings where the alignment algorithm fails to locate the mark.

6.4. The SEM dwell times should match pattern generator speed, i.e. dwell times of 50 ns or lower should be supported.

6.5. A workstation with a Windows software environment with the capability of interfacing with the system interlocks, and essential software, including proximity effect correction software, for patterning and features.

6.6. The design software should be capable of supporting design pre-processing offline. Floating network license or remote login for offline processing is preferable.

6.7. Second software license for offline processes along with the latest and compatible computer system should be provided.

6.8. The system should be capable of accepting DXF, GDSII and other common imaging formats pattern files. Vendor should clearly mention all the other pattern file types that the system is able to accept.

7. System safety and accessories:

7.1. Calibrations and corrections for deflection, focus, astigmatism and height variations.

7.2. Measurement and calibration of beam current, beam position, focus, field size and height must be provided.

7.3. The tool must come with a complement of interlocks to prevent common user errors. Any malfunction or error should display screen error message/signal.

7.4. The system should have sufficient interlocks for safety against malfunctioning of power, vacuum, compressed air and water supply.

7.5. Gun should have adequate interlocks and isolation valves for protection against gun trips.

7.6. Vendor should provide detailed vibration isolations, utility parameters for the best performance of the instrument.

8. Detectors:

8.1. Secondary electron detector should be provided.

8.2. Back scattered electron detector should be provided.

9. Current measurement:

9.1. A picoammeter should be provided with a minimum resolution of the order of 10 *f*A and maximum detected current matching the SEM current.

9.2. All the sample holders/stage should have Faraday Cup with an integrated auto range pico-ammeter having an accuracy of better than 0.5%.

10. Installation, Training, spares and warranty

10.1 The end system should be capable to expose grating patterns with a linewidth of 40 nm or less with a gap of 40 nm or less and isolated line with minimum feature size of ≤ 10 nm.

10.2 The complete system must have a comprehensive warranty of 01 year (for the complete system) with support for spares and accessories continuously for up to 10 years from the date of Installation.

10.3 Standard accessories such as necessary tools, maintenance kit etc. should be provided.

10.4 System installation and commissioning at the CSIR-NPL New Delhi is to be done by the vendor/supplier and the full capability of the system has to be demonstrated as per the acceptance criteria .

10.5 A hands-on training course for the users, by experts/engineers, for using the instrument after the installation process is complete on a set of data for at least two users onsite for 5 working days. Maintenance-level training also to be provided.

10.6 A complete technical manual shall be supplied listing all the capabilities and operations of the instrument.

10.7 Vendor should recommend suitable resist and developer for best pattern fidelity, uniformity, and yield. Vendor should provide resist coated wafers for patterning of 10 nm features for installation, commissioning and training purpose.

10.8 Copies of customer feedback/installation reports for the quoted system from at least 3 different installations shall be submitted.

10.9 Site Survey and pre-installation requirements including the utilities (EM noise, acoustic and floor vibration measurements on-site & computer analysis of the impact on system performance; supply check) and utility parameters by supplier engineers.

10.10 Vendor has to provide the pre-installation requirement to the customer which should include the details of all the utilities being required for operation of the electron beam writing tool.

10.11 Provision for factory acceptance test of the complete system at the factory by the team of 2 persons of CSIR-National Physical Laboratory, New Delhi. The expenditure shall be borne by the CSIR-National Physical Laboratory.

10.12 Vendor should have service support in Indi with qualified Engineers with relevant experience of 2 years or more.

11. Acceptance criteria

11.1 Demonstration of beam current and stability as per the quoted system.
11.2 Demonstration of beam position stability as per the quoted system.
11.3 Demonstration of overlay accuracy as per the quoted system.
11.4 Demonstration of field stitching as per the quoted system.
11.5 Demonstration of isolated line of minimum feature size of less than 10 nm.
11.6 Demonstration of grating patterns with a linewidth of 40 nm or less with a gap of 40 nm or less.

12. General terms and conditions

12.1 Any item not specifically mentioned in the technical specification but essential for successful implementation of the system must be quoted.
12.2 Bidders should clearly specify after sales, the service/application support/AMC capabilities.
12.3 Bidders are requested to specify the comprehensive annual maintenance contract (CAMC) and AMC charges applicable after completion of standard warranty period.
12.4 Provide all information related to pre-installation requirements (i.e. room, environment, air filters, temperature, area, etc.) for the system installation.
12.5 Original warranty certificate to be provided for all the procured items.
12.6 The electrical power input requirements of all the equipment and accessories should be as per Indian standards.

All other terms & conditions of said tender will remain the same.

Sr. Controller of Stores & Purchase

Indentor's recommendation on requests/queries raised in Pre-bid Conference Meeting

(1) A pre-bid conference (PBC) meeting was held online on 18th March 2025 at the Director's conference room, Main building, CSIR-NPL. The following firms participated in the PBC meeting:
(i) Raith India Pvt. Ltd. Bangalore – 560054, India; OEM: Raith GmbH, 44263 Dortmund, Germany (Mr. Masum Khan)
2. Participating bidders raised the following queries:

Name of the Firm	**Queries Raised**	**Remarks, if any**
Raith India Pvt. Ltd. Bangalore – 560054, India; OEM: Raith GmbH, 44263 Dortmund, Germany	**Back scattered electron detector.** Provides best electron detection results for optimum electron beam lithography performance, high contrast imaging and collection of analytical sample information. Backscattered detectors can help a lot depending on the nature of alignment marks, can yield much better signal as secondary detector for overlay/ mark registration First, it improves secondary electron collection efficiency. Especially at low voltages, that should be applied when doing research on e.g. nanowires, the detector delivers brighter images with crisp contrast and excellent surface information. Finally bright and precise detection of markers improves stitching and overlay calibration results to the world class in electron beam lithography. Highly symmetric and shadow free secondary electron intensity distributions support the benefits of the large variety of systems overlay metrology functions that are essential if you are working on samples with difficult contrast mechanisms e.g. uncoated resist. Second, the combined secondary and backscattered electron detector adds a fully integrated BSE detection scheme to the system making it the ideal choice for compositional imaging and metrology. The additional compositional information further improves multilayer registration: not only markers with topography but also material contrast can now be detected. The backscattered detector is less sensitive for edge contrast and charging effects which allows for analytical sample investigation such as precise detection of composition or magnetic domains for imaging and metrology tasks. It even offers unique material contrasts which allow to discriminate materials in different chemical bonding states. Our Request: **Much needed specification.** 10. 2) **Comprehensive warranty (may be for 2 years)** The comprehensive warranty offers peace-of-mind (to ensure	

	the instrument investment remains operational) and offers minimal administration overheads (because no individual repair orders are necessary if instrument service is required). Our Request: **Much needed specification.**	

Indentor's recommendation

The comments, as received from bidders during PBC, and our response is as follows:

Tender Specification and its number	Comment of participating firm/OEM in PBC	Response of Indentor (Accepted/ Not accepted)	Revised specification (If any)	Justification for non-acceptance
Additional technical specification Under **section 8: Detectors**	**Back scattered electron detector.** Backscattered detectors can help a lot depending on the nature of alignment marks, can yield much better signal as secondary detector for overlay/ mark registration First, it improves secondary electron collection efficiency. Especially at low voltages, that should be applied when doing research on e.g. nanowires, the detector delivers brighter images with crisp contrast and excellent surface information. Finally bright and precise detection of markers improves stitching and overlay calibration results to the world class in electron beam lithography. Highly symmetric and shadow free secondary electron intensity distributions support the benefits of the large variety of systems overlay metrology functions that are essential if you are working on samples with difficult contrast mechanisms e.g. uncoated resist. Second, the combined secondary and backscattered electron detector adds a fully	Accepted	8.2: Back scattered electron detector should be provided.	

	integrated BSE detection scheme to the system making it the ideal choice for compositional imaging and metrology. The additional compositional information further improves multilayer registration: not only markers with topography but also material contrast can now be detected. The backscattered detector is less sensitive for edge contrast and charging effects which allows for analytical sample investigation such as precise detection of composition or magnetic domains for imaging and metrology tasks. It even offers unique material contrasts which allow to discriminate materials in different chemical bonding states. (Raith India Pvt. Ltd. Bangalore – 560054, India; OEM: Raith GmbH, 44263 Dortmund, Germany)			
10.2 The complete system must have a comprehensive warranty of 01 year (for the complete system) with support for spares and accessories continuously for up to 10 years from the date of Installation.	**Comprehensive warranty (may be for 2 years)** The comprehensive warranty offers peace-of-mind (to ensure the instrument investment remains operational) and offers minimal administration overheads (because no individual repair orders are necessary if instrument service is required). (Raith India Pvt. Ltd. Bangalore – 560054, India; OEM: Raith GmbH, 44263 Dortmund, Germany)	Not Accepted		Bidders are requested to specify the comprehensive annual maintenance contract (CAMC) and AMC charges applicable after completion of standard warranty period.

TSC Minutes

The PBC/TSC meeting was held on 18th March 2025 at the Director's conference room, Main building, to finalize the technical specifications of "Electron Beam Lithography System".

The meeting was attended by all the TSC members.

Based on the Pre-bid meeting and recommendation of I/O, following changes have been made in the specifications:

Original Specifications	Final Specifications
dditional technical specification und ection 8: Detectors	2 Back scattered electron detector should be provided.
dditional technical specification und ection 12: General terms and conditions	2.3 Bidders are requested to specify the comprehensiv nnual maintenance contract (CAMC) and AMC charge pplicable after completion of standard warranty period.

The file is forwarded to Purchase Section for uploading the final specifications and TSC minutes on the website and CPPP Portal.

Declaration: We hereby declare that we have no conflict of interest with any of the bidder in this tender