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From: Director, CSIR-NPL
Tender No. 14-VI/SSK(1102)22PB/T-12 Dated: 17.05.2023

CORRIGENDUM

With reference to NPL's Global Tender ID: **2023_CSIR_708358_1**, Pre-Bid Conference (PBC) was concluded on 02.05.2023 for "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:**

Essential Specifications:

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, beam energy ≥ 30 keV, routinely useable. All the electron energy values for which the system is calibrated should be clearly mentioned.
   - 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-7 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 ± 1 °C.
   - 2.2. Beam current stability ≤ 1% over 4 hrs or larger time at ambient with fluctuation of ± 1 °C.
   - 2.3. Beam diameter: ≤2 nm.
   - 2.4. Electrostatic beam blanking system, with a speed consistent with the pattern writing speed of the system, should be provided.

3. **Lithography resolution**:
   - 3.1. The system should be capable of writing minimum feature size of 10 nm or less.
   - 3.2. The system should be capable of writing arrays of 40 nm lines with a gap of 40 nm or less.
   - 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 stage should be controllable by external hardware or using the control software of the system, by scripting and by pointing on the scanned images.
   4.2. A 100 × 100 mm travel range laser interferometer controlled stage (based on a frequency stabilized HeNe laser source) for xy 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 and in the z-direction the resolution should be < 100 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 pressures ≤ 5E-4 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 and load lock chambers should have adequate safety interlocks and alarms to prevent jamming of the loading arm/rod for loading of wafer holders on the stage.
   5.5. Load lock should be able to pump down to pressures ≤1 Pa.
   5.6. System should be equipped with dry vacuum pumps for oil-free system vacuum.
   5.7. Both chambers 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 at least at 20 MHz. All base primitives should be available (e.g. circle, rectangle, triangle, polygon), vector scans will be added advantage.
   6.2. Automated and Manual alignment should be supported.
   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. Stigmation correction and autofocus should be supported.
   6.5. The SEM dwell times should match pattern generator speed, i.e. dwell times of 50 ns or lower should be supported by scan electrodes of the SEM.
   6.6. A workstation with a Windows software environment with the capability of interfacing with the system interlocks, essential softwares, including proximity effect correction software, for patterning and features.
   6.7. The design software should be capable of supporting design pre-processing offline. Floating network license or remote login for offline processing is preferable.
   6.8. Second software license for offline process with a display along with hardware accessories and data storage.
   6.9. Zero stitching error facility/mode for writing long and periodic structures like waveguides, meander, and gratings etc.
   6.10. The system should be capable of accepting DXF and GDSII 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. The supplier should provide necessary arrangements with suitable interlocks to maintain the temperature fluctuation of ± 0.1 °C in the system.

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

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

7.4. The vendor should provide requirements for vibration isolation.

7.5. Vendor should provide detailed 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 minimum resolution of the order of *f*A and maximum detected current matching the SEM current.

9.2. Faraday cup should be available at a convenient location on the sample holder or the stage.

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 05 years (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 to complete satisfaction.

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 Installation requirements of the quoted item must be submitted with the technical bid.

10.8 Vendor should provide compatible resists and developer for patterning of 10 nm features.

10.9 Copies of customer feedback/installation reports, from at least 3 different installations shall be submitted.

10.10 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.

10.11 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.

10.12 Provision for pre-shipment instrument inspection and acceptance of the complete system at the factory by the CSIR-National Physical Laboratory, New Delhi. The expenditure shall be borne by the CSIR-National Physical Laboratory.

10.13 Vendor should have service support with qualified Engineers with relevant experience.

11. General terms and conditions

11.1. Any item not specifically mentioned in the technical specification but essential for successful implementation of the system must be brought to our notice and quoted accordingly.

11.2. Bidders should clearly specify after sales, the service/application support/AMC capabilities.

11.3. Provide all information related to pre-installation requirements (i.e. room, environment, air filters, temperature, area, etc.) for the system installation.

11.4. Original warranty certificate to be provided for all the procured items.

11.5. The electrical power input requirements of all the equipment and accessories should be as per Indian standards.

Therefore, following extension in due date of submission & date of opening of the said tender may be read exactly as follows:

Due date & time of tender submission
For : 23.05.2023 up to 3;00 PM (IST)
Read as: 30.05.2023 up to 3;00 PM (IST)

Date & Time of Tender Opening
For : 24.05.2023 at 3:00 PM (IST)
Read as: 31.05.2023 at 3:00 PM (IST)

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

Sr. Controller of Stores & Purchase

"Electron Beam Lithography"

<u>Changes made after per pre-bid meeting</u>

Before pre-bid meeting	After pre-bid meeting
The e-beam current to the samples should be $\leq$10 pA to 10 nA or more.	The e-beam current to the samples should be $\leq$ 100 pA to 10 nA or more.
Fast electrostatic beam blanking at 20 MHz or higher	Electrostatic beam blanking system, with a speed consistent with the pattern writing speed of the system, should be provided.
The system should be capable of writing gratings with a linewidth of 40 nm or less with a pitch of 40 nm or less.	The system should be capable of writing arrays of 40 nm lines with a gap of 40 nm or less.
The movement of stage should be controllable by external hardware, by scripting and by pointing on the scanned images.	The movement of stage should be controllable by external hardware or using the control software of the system, by scripting and by pointing on the scanned images.
The resolution for X and Y movement of the laser interferometric stage should be $<$ 1 nm and in the z-direction the resolution should be $<$ 100 nm.	The resolution for X and Y movement of the laser interferometric stage should be $\leq$ 1 nm and in the z-direction the resolution should be $<$ 100 nm.
Main chamber should have CCD Camera	If the operation of the system requires a CCD camera in the main chamber, the same should be provided by the vendor.
Automatic field and stigmation correction, and autofocus using scripts should be supported.	Stigmation correction and autofocus should be supported.
The SEM dwell times should match pattern generator speed, i.e. dwell times of 10 ns or lower should be supported by scan electrodes of the SEM.	The SEM dwell times should match pattern generator speed, i.e. dwell times of 50 ns or lower should be supported by scan electrodes of the SEM.
A workstation with a Windows software environment with the capability of interfacing with the system interlocks, essential softwares for patterning and features.	A workstation with a Windows software environment with the capability of interfacing with the system interlocks, essential softwares, including proximity effect correction software, for patterning and features.
Advance error free stitching software packages for no pattern displacements.	Zero stitching error facility/mode for writing long and periodic structures like waveguides, meander, and gratings etc.

The supplies should provide a water chiller with a closed circuit and interlock with a temperature fluctuation of ± 0.1 °C.	The supplier should provide necessary arrangements with suitable interlocks to maintain the temperature fluctuation of ± 0.1 °C in the system.
Secondary electron detector and high efficiency in-lens secondary electron detector should be provided.	Secondary electron detector should be provided.
Back scattered electron detector, Secondary electron detector and high efficiency in-lens secondary electron detector should be provided.	Back scattered electron detector should be provided.
The end system should be capable to expose grating patterns with a linewidth of 40 nm or less with a pitch of 40 nm or less and isolated line with minimum feature size of ≤ 10 nm.	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.

Sunil Singh