



INDIAN INSTITUTE OF TECHNOLOGY BOMBAY
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Technical Specifications for High Throughput E-beam Lithography

RFX NO. 610000811 (Reference No. 100018325)

Tender Specification for high throughput electron beam lithography

1. General requirements
1.1. High Performance and high throughput Electron Beam Lithography System for advanced Nanolithography consisting of electron optics, stage-chamber unit, vacuum control, control electronics, comprehensive control software and operating PC
1.2. System must offer high resolution SEM imaging functions for result inspection and metrology
1.3. Instrument must be delivered with temperature stabilized housing to relax site requirements down to +/-2°C
1.4. System must run factory and site acceptance
1.5. System must have small footprint of maximum 4.5m* for main system
1.6. Vendor must provide installation and initial onsite training
1.7. Vendor must have installed at least five dedicated ebl systems in India and must have a local service & support office in India.
1.8. System must include Uninterrupted Power Supply with minimum 30 min autonomy time and automated safe shut down routine
2. Electron Optics requirement
2.1. Thermal Field Emission (TFE) Schottky Emitter
2.2. Beam energy selectable between 10 and 50 keV, in 1V step size delivered by modern and compact switch mode power supplies
2.3. Ultra fast BSE detector
2.4. Three lens optics with minimized alignment requirement
2.5. Electrostatic beam deflection capable of deflecting the beam up to 500gm x 500 km without the need of additional subfield deflection to reduce calibrations
2.6. Zoom condenser lens arrangement for continuous beam current adjustment
3. Stage and chamber requirements
3.1. Stage travel range in XY plane 150 mm x 150 mm
3.2. Vertical stage travel range 15 mm for higher flexibility sample thickness
3.3. Stage mounted to the top chamber plate to have ONE reference for column and stage
3.4. Stage positioning by hybrid DC motor coarse and Piezo drive fine positioning with 1 nm stage movement resolution independent of working distance and beam deflection
3.5. Load lock capable of loading up to 200 mm wide samples (8" wafer, 7" mask) with automated stage transfer procedure to the kinematic — stress free — mounting on stage
3.6. Automatic on stage sample holder levelling by built in lift Piezo elements
3.7. CCD camera for sample navigation
3.8. Universal sample holder that can hold small pieces and wafers up to 4 inch diameter
4. Pattern and Scan Generator
4.1. 50MHz maximum scan speed
4.2. 18-bit analogue resolution
4.3. Future proof upgradable FPGA (Field Programmable Field Array) architecture
4.4. Pixel to pixel continuous corrections of in field astigmatism, focus and distortion in real time
4.5. 64-bit operating system with 32Gbyte memory to handle large CAD data
4.6. Water cooled circuits for highest stability and accurate DAC performance
4.7. Capable of Vector Scan lithography
4.8. Capable of exposing huge gray scale Bitmaps

4.9. Capable of Marker and SEM Image Acquisition
5. System control software
5.1. General
5.1.1. Operating software must be capable of handling multiple user at different user experience levels

5.1.2. Operating software must control all system functions and support service and maintenance routines
5.1.3. Operating software must be capable of full lithography workflow from pattern design and import, pattern postprocessing and proximity correction, result simulation, job setup and exposure execution
5.1.4. Operating software must be capable of SEM imaging for result inspection, including archiving, annotations and metrology
5.1.5. Operating software must support CAD based sample navigation for convenient revisiting sample sites of interest
5.1.6. Operating software must be capable of automated large area image acquisition
5.1.7. A second offline software license for data preparation must be made available
5.1.8. Extensive PYTHON scripting functions and remote control for operation and remote diagnostics must be available
5.1.9. An easy standalone software package that allows internal non-EBL experienced customers to create EBL jobs offline
5.2. Lithography function
5.2.1. Built in hierarchical GDSII layout editor with EBL specific shape information like exposure dose and exposure strategy
5.2.2. Built in proximity effect correction, monte carlo based proximity parameter determination, 3D resist development simulation and data postprocessing
5.2.3. Exposure strategy vector scan step & repeat
5.2.4. Exposure strategy Grayscale BITMAP with mosaic import and preview function must be available.
5.2.5. Exposure strategy Fixed Beam Moving Stage for writing continuous paths without stitching error must be available.
5.2.6. Exposure strategy Modulated Beam Moving Stage for writing periodic patterns without stitching error must be available.
5.2.7. Patterning direction must be completely flexible per pattern shape to ensure optimum results
5.3. SEM function
5.3.1. Image acquisition with flexible scan speed, noise reduction and archiving
5.3.2. CAD based precise relocation of point of interest
5.3.3. Annotation editor for images
5.3.4. Image archiving functions
6. Specifications
6.1. Guaranteed minimum linewidth $\leq 10\text{nm}$
6.2. Guaranteed minimum grating period $\leq 40\text{nm}$
6.3. Field stitching guaranteed $\leq 20\text{ nm } ([\text{mean}] + 3\text{ sigma})$
6.4. Overlay accuracy guaranteed $\leq 20\text{ nm } ([\text{mean}] + 3\text{ sigma})$
6.5. It is essential that the vendor provides a detailed description of measurement procedures of specification 6.1.-6.4
7. System should be offered with
7.1. Automated Height Sensing for 4" up to 8" laser based measurement and correction of working distance
7.2. Two Wafer holders for 3 inch wafer
7.3. Two Rotation and Tilt module for 6 inch system
7.4. Fixed Beam Moving Stage Writing Strategy
7.4.1. Stage should follow arbitrary curved paths at constant speed to expose elongated pattern without stitching errors
7.4.2. GDSII editor must be able to define these patterns beside conventional step and repeat
7.4.3. Necessary calibrations and parameter must be defined and completely integrated within the system operation software package
7.5. Modulated Beam Moving Stage Writing Strategy
7.5.1. Stage moves at constant speed while beam is deflected with low noise and user defined elementary shape arrangement to create a periodic pattern without stitching over several mm
7.5.2. GDSII editor must be able to define this pattern beside conventional step and repeat pattern shapes

7.5.3. Necessary calibrations and parameter must be defined and completely integrated within the system operation software package
7.6. Backscatter Electron Detector
7.7. Additional five off line licenses must be offered
7.8. Service contract for four years
8. System infrastructure
8.1. System must be delivered with necessary closed loop cooling system
8.2. Site survey must be performed and report submitted within 2 months after contract concluded
8.3. Possibility to install system in gray room but sample loading and operation is done from clean room
Warranty- For E-Beam Lithography (EBL), a 12 months warranty after acceptance, but at maximum 15 months from date of delivery. For EBL software, standard terms of delivery apply.