INDIAN INSTITUTE OF TECHNOLOGY BOMBAY
MATERIALS MANAGEMENT DIVISION

PR NO. 1000057649 **Rfx 6100003187**

Technical Specifications for Direct Writing Lithography System (1 Unit)

Sr. No	Description	Value / Range	Technical Compliance (YES / NO)	Additional Information (if any)
A. Direct Writing Lithography System (Features / Specifications)				
A.1	Writable Area	190mm X 190mm or larger		
A.2	Exposure Resolutions (At least five different resolutions should be available on the system)	A.2.i. ≤ 0.4 µm		
		A.2.ii. ≤ 0.6 µm		
		A.2.iii. 1.0± 0.1 µm		
		A.2.iv. 2.0± 0.1 µm		
		A.2.v. 5.0± 0.1 µm		
		Automatic selection of resolution through the software should be possible. No manual lens changing should be required.		
A.3	Edge Roughness	≤ 40 nm (rms) at best resolution		
A.4	Level to level Alignment accuracy	500 nm or better		
A.5	Writing Speed	A.5.i.3 mm2/minute or faster @0.4 µm resolution		
		A.5.ii.15 mm2/minute or faster @ 0.6 µm		
		A.5.iii.45 mm2/minute or faster @1.0 µm resolution		
		A.5.iv.120 mm2/minute or faster @2.0 µm		
		A.5.v.175 mm2/minute or faster @5.0 µm		
A.6	Substrate Holding	A.6.i. Vacuum or friction-based mechanism should be provided for keeping all wafers in position		
		A.6.ii. System must have multiple wafer handling features so that the multiple samples from different users can be exposed overnight.		
		A.6.iii. Vendor must explain detailed mechanisms to handle thin and delicate wafers in the system		
		A.6.iv. Provide the details of the system capabilities to facilitate processing of wafers having bow/warp or variable thickness.		
		A.6.v. Automatic wafer centering feature is desired		
B. Lithography source details				
B.1	Source type	Semiconductor Laser/LED Source		
B.2	Guaranteed Lifetime	≥ 20000 hours for each light source		
B.3	Wavelength	B.3.i. System must have two integrated light-sources of 405nm and 365nm for optimum performance with all kind of photoresists.		
		B.3.ii. Selection of Exposure wavelength of 405nm or 365nm should be possible through software and should not require any manual changes to keep all the alignments in place.		
		B.3.iii. Both light sources should use DLP technology for a fast writing speed.		
B.4	Power	1.5 W or higher		
C. Exposure and Control				
C.	Control	Both automatic and manual		
C. 2	Grey scale Mode	750 or more Grey scale mode for three-dimensional patterning		

C.3	Focus	Automatic focus with real time surface tracking must be available.		
D. Interferometer Specifications				
D.1	Interferometer resolution	System should have XY interferometer with 2 nm or better resolution for precise motion control		
E. Stage Assembly Specifications				
E.1	Stage travel range	E.1.i. X axis ≥ 200 mm		
		E.1.ii. Y axis ≥ 200 mm		
		E.1.iii. Z axis ≥ 15 mm		
E.2	Resolution of stage movement	5 nm or better. Details about stage movement must be mentioned to avoid / rectify stitching errors		
F. Control hardware and software				
F.1	Data Formats	TIFF, CIF, GDSII, BMP, JPEG, PNG, GIF etc.		
F.2	Control Hardware and Software	System should have control electronics and software for controlling autofocus system, image processing hardware etc. The firm should provide detailed features and capabilities of data processing and control software		
F.3	Software upgrades	Software upgrades should be available free of cost		
F.4	Workstation	Latest Windows based Computer for system		
F.5	Write time estimation and intimation	The system should have the capability to calculate automatically the estimated time required to expose the substrate before starting of the writing process. System software (MW3 software) with additional two license keys to be installed in other computers outside the lab for user access for calculating the writing time.		
F.6	Mask Design Software	Latest version of any professional mask design software or layout editor is to be supplied preloaded with the system, with additional two licensed keys to be installed in other computers for		
F.7	System Environment Stability	Environment chamber for controlled and stable environment during system operation should be provided with the system. The details of the variables controlled and their limits should be		
F.8	Communication module	It is preferred to have a communications module with the machine which can send emails to users informing them of progress during long exposures and a message indicating that an exposure has finished		
G. Substrates/wafers				
G.1	Substrate sizes	9 Inch X 9 Inch or bigger. There should not be any minimum substrate size limitation		
G.2	Substrate thickness	G.2.i.15 mm or thicker substrates should be accepted		
		G.2.ii.Should be also able to handle thinner substrate of few mm thick		
G.3	Substrate types	System must work with GaN, SiC, SiO2, Ceramic, Diamond, Sapphire, Silicon, Flexible substrates, Glass etc. substrate types		
H. Photoresist				
H.1	Photo resist type	The system must be capable of processing all the photoresist including g-, h- and i-line resists, SU8 etc. to the optimum level.		
I. Camera, optical microscope, profiler with features				
I.1	Camera pixels	≥ 1272 x 1024 Camera pixel size and resolution must be		
I.2	Camera feature	For Substrate inspection, automatic and manual alignment, dimension measurements		
I.3	Microscope	Automatic change of magnification using software, no manual change of lens required		

I.4	Profiler	System should have optical profiler for examining deposited layers, exposed resists and other processes. Vendors should mention resolution.		
I.5	Features	I.5.i. An in-built automatic Wafer inspection tool		
		I.5.ii. Pre-visualization of the exposure to come onto the real-time camera view, for checking alignment for example		
		I.5.iii.Export image tool allowing exposures to be designed directly on top of an image taken from the real-time microscope		
I.6	Backside alignment	I.6.i.System must offer a backside alignment feature to align structures on both sides of a wafer		
		I.6.ii. It must include a dedicated backside alignment camera which can provide real-time images with at least 2µ micron resolution		
J. Installation and Process Acceptance				
J.1	Acceptance criteria	J.1.i. As per Annexure I provided below, all the items specified therein shall be considered as the acceptance criteria for this tender		
		J.1.ii. After the successful installation, Supplier should provide user training for two days. It specifically includes: Loading of substrate, alignment, setting up exposure and all other parameters and unloading. (Details as per Annexure I)		
		J.1.iii. Supplier will have to demonstrate the feature size, speed and other alignment parameters at our site. (Details as per Annexure I)		
		J.1.iv. Optical alignment and software-controlled calibration using standard sample (Details as per Annexure I)		
K. System accessories				
K.1	Accessories	K.1.i. An active or passive vibration Isolation table should be provided along with the system		
		K.1.ii. System should be supplied with all necessary safety interlocks and switches for safe operation including suitable light with its details		
L. Service and Warranty				
L.1	Service	Manufacturer should have their service support/ office in India. There must be a provision for the remote control of the system for trouble shooting purposes		
L.2	Warranty	Minimum 2-year warranty from the date of installation		
M. Other Conditions				
M.1	Mandatory Condition	M.1.i. Supplier should have supplied at least 5 similar systems in India for proven capability. A user list with the similar systems to be provided.		
		M.1.ii. Spare parts must be available for a minimum of 10 years from the OEM and Indian counterpart		
		M.1.iii. Suppliers must confirm that they provide a free of charge remote service for issues for a minimum 10 years. Add the telephone number and email and persons on the hotline. Telephone/web response time max 30 min.		
		M.1.iv. Service visit response by engineer time max 2 working days.		

ANNEXURE I – Process Acceptance

Objective

This document defines the acceptance criteria and validation procedures to verify that the Direct-Write Lithography System meets the required technical and process specifications.

1. Scope

- System installation and commissioning
- Functional and performance validation
- Process capability verification
- Software and hardware compliance
- User training and documentation

2. Photoresist Information for Acceptance Testing

The following standard photoresists shall be used during acceptance testing:

Sr. No	Resist Type	Name	Thickness range
1	Positive Photoresist	S1813 / S1805 (g, h, and i-line compatible)	0.5 – 1.5 µm
2	Negative Photoresist	SU-8 series (2002, 2025, 2050, 2100 etc.)	2 µm – 100 µm

Acceptance Criteria for Resist Processing:

- Uniform exposure across the substrate and proper development/linewidth control.
- Clean pattern transfer with no resist burning, footing, or scumming.
- Repeatable exposure performance.

3. Acceptance Criteria Overview

The system shall be accepted only after successful verification of pattern writing performance, optical source compliance, stage accuracy, exposure control, substrate compatibility, imaging/alignment systems, software functionality, environmental stability, safety, and training.

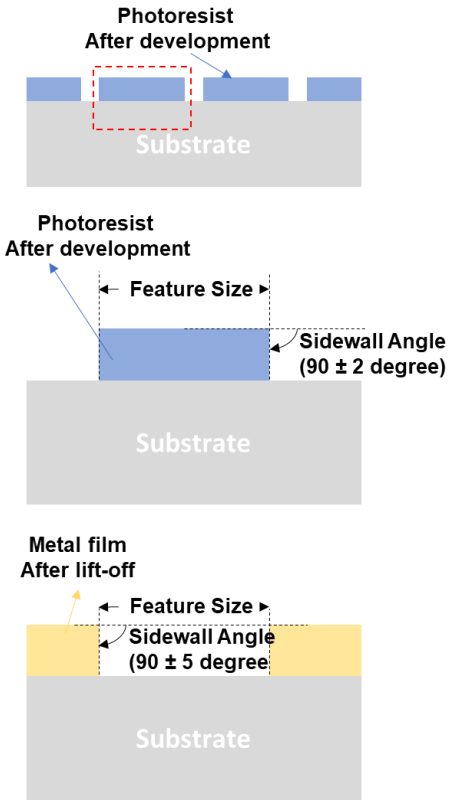
4. Detailed Acceptance Procedure

4.1 Installation Verification

- System installed as per vendor specification with functional vibration isolation table and environmental chamber.
- **Acceptance Condition:** System powered ON without errors; power and safety interlocks functional.

4.2 Pattern Writing Performance Validation

Parameter	Specification	Test Method	Acceptance
Writable Area	≥ 190 mm × 190 mm	Stage scan verification	Pass/Fail
Resolution	≤ 0.4 to 5 µm (multi-scale)	SEM Analysis of test pattern after metal deposition	Pass/Fail
Edge Roughness	≤ 40 nm RMS for 400 nm feature	Cross-SEM measurement	Pass/Fail
Top-side Alignment Accuracy	**≤ 500 nm overlay accuracy**	**2-layer overlay test across the 190 mm area. Measured at 5 points: North, South, East, West, and Center.**	**Pass/Fail**
Backside Alignment Accuracy	**≤ 2 µm overlay accuracy**	**Alignment demonstrated across the 190 mm area. Measured at 5 points: North, South, East, West, and Center.**	**Pass/Fail**

Sidewall Profile	**After Development - Sidewall Angle (90 ± 2 degree)**	**Cross-sectional SEM** 	**Pass/Fail**
	After liftoff - Sidewall Angle (90 ± 5 degree)		**Pass/Fail**

4.3 Writing Speed Verification
Acceptance Condition: All speeds meet or exceed the following values:

- **0.4 µm:** ≥ 3 mm²/min
- **0.6 µm:** ≥ 15 mm²/min
- **1.0 µm:** ≥ 45 mm²/min
- **2.0 µm:** ≥ 120 mm²/min
- **5.0 µm:** ≥ 175 mm²/min

4.4 Optical Source Validation

- **Sources:** Integrated 365 nm and 405 nm semiconductor Laser/LED sources with software-controlled switching.
- **Performance:** Source power ≥ 1.5 W with a lifetime ≥ 20,000 hours.
- **Resolution Demonstration: The vendor must demonstrate the highest possible resolution for both 365 nm and 405 nm wavelengths (as per resist and tool limits).**
- **Resist Selection: Photoresist must be chosen based on specific compatibility for each wavelength tested.**
- **Acceptance Condition:** Both wavelengths functional, selectable via software, and resolution benchmarks met.

4.5 Stage and Motion System Verification

- **Travel:** X-Y Travel ≥ 200 mm; Z Travel ≥ 15 mm.
- **Precision:** Resolution ≤ 5 nm; Interferometer Resolution ≤ 2 nm.
- **Tests:** Repeatability demonstrated on three consecutive runs and stitching error correction measured by SEM.

4.6 Focus and Exposure Control

- **Features:** Real-time surface tracking autofocus, ≥ 750 grayscale levels, and software switching between automatic and manual exposure modes.

- **Acceptance Condition:** Stable focus maintained across the entire wafer.

4.7 Substrate Handling Validation

- **Compatibility:** Silicon, Glass, Sapphire, and Flexible substrates.
- **Mechanical:** Verification of vacuum/friction holding, thin wafer handling, bow/warp compensation, and automatic centering.

4.8 Software and Data Compatibility

- **Formats:** TIFF, GDSII, BMP, JPEG, PNG, etc.
- **Tools:** Write-time estimation and mask design software.
- **Acceptance Condition:** All formats load and process correctly; free lifetime upgrades provided.

4.9 Imaging and Alignment System

- **Components:** Microscope with auto-magnification, camera (≥ 1272 × 1024 pixels), and optical profiler.
- **Backside Alignment:** Resolution ≤ 2 µm (overlay accuracy defined in Section 6.2).

4.10 – 4.12 Environment, Automation, and Safety

- **Environment:** Controlled chamber with vibration isolation; stable during long exposures.
- **Automation:** Email notifications and overnight exposure scheduling.
- **Safety:** Emergency stop (with shutdown/restart functionality), light shielding, and interlocks.

5. Demonstration Requirements (On-site)

The vendor must demonstrate the following at the installation site (Minimum Feature size capability to be demonstrated for both post development and post metallization process):

- **0.4 µm feature size capability** over the full 190 mm x 190 mm writing area.
- **Top-side Alignment: ≤ 500 nm overlay accuracy** measured at **5 points (North, South, East, West, and Center.)** across the full area for multi-layer exposure.
- **Backside Alignment: ≤ 2 µm overlay accuracy** measured at **5 points (North, South, East, West, and Center.)** across a full wafer.
- **High-Resolution Wavelength Test:** Highest possible resolution for **both 365 nm and 405 nm** using wavelength-compatible resists.
- **System Functions:** Writing speed compliance, autofocus operation, and software calibration.

6. Substrate and Material Compatibility

Supports Silicon, Glass, Sapphire, Diamond, Ceramic, SiC, SiO_2, Flexible substrates, and GaN wafers.

- **Thickness:** Supports thin substrates (few mm) up to thick substrates (15 mm or more).

7. Acceptance Checklist

(Items 1–7 covering Installation, Writing, Optical Source, Stage, Software, Substrate Handling, Imaging, Safety, and Training).