



**INDIAN INSTITUTE OF TECHNOLOGY BOMBAY**  
**MATERIALS MANAGEMENT DIVISION**  
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**PR No. 1000018326 (Rfx No. 6100000912)**

**Detailed Technical Specifications for Multi-material atomic layer deposition(ALD) system**

**1. ALD SYSTEM**

• **Key Generic Requirements:**

- a. The tenderer must provide an installation scheme showing the physical space (footprint) of the item(s) as well as space required for routine access and all installations including related accessories
- b. The vendor should have installed similar types of atleast 2 systems in centrally funded technical institutes or government research labs. Purchase order(PO) and user list should be provided as supporting evidence
- c. The compliance sheet should be provided by the vendor. The absence of the compliance sheet may result in the cancellation of the purchase order
- d. For each compliance, supporting evidence such as manuals and other necessary and supporting documents needs to be provided
- e. The vendor should have an Indian representative which can take care of the urgent troubleshooting or any queries on an urgent basis
- f. Installation and training of the system should be demonstrated

• **Technical Specifications (Generic):**

- a. The primary purpose of the system is to deposit dielectric (oxide and nitride) and metal films based on sequential use of gas phase chemical process
- b. The system should have the ability to deposit a wide variety of thin film materials using thermal and plasma-enhanced atomic layer deposition

- **Technical Specifications (Specific):**

- A. Deposition chamber**

- i. Flow-optimized ALD chamber for thermal and plasma depositions
- ii. Continuous, exposure and plasma-based operational modes
- iii. Deposition on substrates up to 8 inch in diameter
- iv. Substrate heating from RT upto minimum of 500 °C
- v.  $<\pm 2\%$  1 sigma film uniformity for thermal and plasma  $\text{Al}_2\text{O}_3$
- vi. Automated load-lock with independent turbo pumping system for low pressures
- vii. Film deposition on high aspect ratio features of 1 : 500 or better
- viii. Analytical port for in-situ ellipsometry
- ix. Analytical port for in-situ quartz crystal microbalance (QCM)
- x. Analytical port for in-situ residual gas analyzer (RGA)
- xi. Analytical port for in-situ optical emission spectrometry (OES)
- xii. System to isolate reaction by-products from pumps
- xiii. Easy deposition of layers and stacks of layers

- B. Precursor delivery system**

- i. ALD reactor should be able to accommodate and function with gas, liquid, and solid precursors
- ii. Minimum of 6 precursor sources
- iii. Precursors individually heatable at least up to 200 °C.
- iv. Heated lines and manifold (at least upto 150 °C), and valves (at least upto 200 °C)
- v. High speed ALD valves( $< 15\text{ms}$ )
- vi. Rapid exchange precursor cylinders with manual valves
- vii. Carrier gas mass flow controller
- viii. Spare precursor cylinders (3 nos.) should be quoted with the system

- C. Plasma design**

- i. Pulsed plasma radical generator with auto-matching network

- ii. Inductively-coupled plasma (ICP) or capacitively-coupled plasma (CCP)
- iii. Variable RF power supply and software interfacing
- iv. Ability to perform thermal and plasma processes in the same recipe
- v. Minimum of 6 gas inlets for plasma
- vi. Plasma gas inlets should be compatible with gas sources for O<sub>2</sub>, O<sub>3</sub>, N<sub>2</sub>, NH<sub>3</sub>, Ar, H<sub>2</sub>S

#### **D. Additional mandatory features**

- i. Deposition using low vapor pressure ( $\geq 0.01$  Torr) precursors should be possible – two low vapor pressure deposition kits to enable this should be quoted in the main system
- ii. High concentration ozone generator (1 number) with software and MFC control (with MFC and other accessories) should be quoted. The MFC controller should have at least 2 extra ports w.r.t the MFCs installed.
- iii. Chamber, precursor delivery and pump hardware should support film depositions and evacuation of by-products using metal-organic and halogen chemistries

#### **E. Additional mandatory equipments**

- i. Spectroscopic ellipsometer integrated with the system from reputed manufacturer should be quoted
- ii. Ellipsometer should be capable of in-situ monitoring with no film deposition on its windows
- iii. Quartz crystal microbalance (QCM) capable of functioning upto 300 °C integrated with the system from reputed manufacturer should be quoted
- iv. Spare crystals (5 nos.) for QCM should be quoted

#### **F. Computer and software**

- i. State-of-the-art computer system (printer, monitor, table etc.) for managing the system with data analysis/acquisition and equipment operation software
- ii. Ability to be controlled remotely via an internal network or the internet
- iii. The operating system should be Windows 10. A free upgrade if necessary should be assured
- iv. Monitors should be at least 19" (diagonal) LCD monitors
- v. Sample recipes should be included that demonstrate different ALD modes
- vi. Recipe library available with the vendor must be made available
- vii. Automatic data logging
- viii. Graphing of precursor pulses versus time
- ix. Built-in software safety interlocks
- x. Over-pressure abort
- xi. Over-temperature abort
- xii. Faulty recipe entry warnings
- xiii. Continuous USB communication monitoring
- xiv. If the windows or the software crashes the vendor should provide onsite support for the same

#### **G. Other components**

- i. Security features protecting the integrity of the vacuum system, in vacuum components, precursor lines and electronics in case of power failure
- ii. Base frame for the system chambers and rack for electronics

#### **H. Power requirement**

- i. 230 VAC single phase or 440 V three phase, 50 Hz
- ii. Electronics control box with safety features
- iii. Emergency off (EMO) switch

## **I. Acceptance criterion**

- i. Vendor should provide measurement results of factory deposited film thickness and uniformity data such as ellipsometry and/or SEM results and it should later match with onsite deposition profiles using IITBNF inhouse SEM and/or ellipsometer.
- ii. Vendor should agree to demonstrate film uniformity specs for 8 inch substrates:  $< \pm 2 \% 1 \text{ sigma}$  over 150 mm for thermal  $\text{Al}_2\text{O}_3$  and plasma  $\text{Al}_2\text{O}_3$  measured onsite by ellipsometry after installation
- iii. Vendor should bring their own demo precursor for the test

## **J. Spares, installation, training, warranty & maintenance**

- i. Supplier should complete installation on-site, provide a minimum of 1 year warranty post installation and on-site training of upto 4 people
- ii. The user manual, maintenance, troubleshoot events, necessary and supporting documents for the system, and other parts used in the system to be provided
- iii. Necessary spare parts for 5 years beyond the warranty period should be quoted with the system
- iv. Supplier should demonstrate deposition of at least one standard film (e.g.  $\text{Al}_2\text{O}_3$ ) conforming to film uniformity and aspect ratio specs of the system in both thermal and plasma modes
- v. Include standards to be used for calibration of tool parameters
- vi. A set of basic tools required for performing routine maintenance. A tool cart that can be locked and that can accommodate these tools should be provided
- vii. The payment terms will be specified in the commercial proposal and is subject to negotiation
- viii. Please provide details of the number of trained personnel in India, number in the western region or in Mumbai who can service the machine
- ix. Please provide references both in India and abroad

- x. The cost of shipping up to IIT Bombay should be included. IIT Bombay will help with customs clearance at Mumbai Airport. Please include your payment option.
- xi. Please list a set of acceptance tests for on-site (vendor) inspection and after installation at IIT Bombay
- xii. All facilities requirements such as compressed air/N<sub>2</sub>/Ar, carrier gas and chilled water should be specified

**2. Additional Precursor Lines (2)**

- **Maximum of 6 precursor ports on system**
- **Includes additional heater jackets and 50mL cylinders**

**3. Additional Plasma gas lines (2)**

**4. Low Vapor Pressure Deposition (LVPD) Option (2 Nos)**

- **No Cylinder**
- **For low vapor pressure precursors > 0.01 Torr**

**5. Liquid Precursor Cylinder (150 ml)**

**6. High Concentration Ozone Generator with software, ~200ng/mL**

**7. Reactor Analysis Ports Upgrade**

- **- Ports for Ellipsometry, RGA and QCM**

**8. Load Lock Automated with Independent Pumping system**

**9. Woollam ISE Ellipsometer**

**10. In-Situ Quartz Crystal Microbalance (QCM)**

**11. crystals (5 nos.) for QCM should be quoted - Spares for system**

**12. Spare Parts Kit (3 Nos)**

- 13. Substrate Bias – 6” max substrate size**
- 14. On-site System Commissioning and Training**
- 15. High temperature chuck (upto 800 °C)**
- 16. Vapor trap - Spares for system**
- 17. Turbo pump - Spares for system**
- 18. Dry rotary pump- Spares for system (2 Nos.)**
- 19. Matching network for plasma generation - Spares for system**
- 20. Water flow switch - Spares for system**
- 21. Precursor cylinders with valves - Spares for system**
- 22. Spare low vapor pressure deposition/booster assembly**
- 23. OES attachment from reputed manufacturer that can be easily integrated should be quoted**
- 24. Substrate holder**