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 at least 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. <±2 % 1 sigma film uniformity for thermal and plasma Al₂O₃
   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(< 15ms)
   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 \( O_2, O_3, N_2, NH_3, Ar, H_2S \)

D. Additional mandatory features

i. Deposition using low vapor pressure (\( \geq 0.01 \text{ Torr} \)) 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 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/N₂/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