

**Technical Specifications of
Plasma enhanced Atomic Layer Deposition (PEALD) system suitable for
deposition of Al₂O₃, AlHfO, AlN, SiO₂ and SiN**

Sl. No.	Description of sub-components
1	<p>System</p> <ul style="list-style-type: none"> • Remote plasma and thermal ALD system. • Thermal and plasma processes can run sequentially as part of a recipe sequence without hardware changes • Chamber made from single metal block with integrated heating for easy opening and closing of chamber (no bolts that need be removed). Removable inner chamber/liners for easy maintenance. • Chamber should have ports for upgrade (to be done later) for in-situ ellipsometry
2	<p>Vacuum performance</p> <ul style="list-style-type: none"> • Base pressure < 5×10^{-6} Torr • Pump down from atmosphere to 1×10^{-5} Torr in under 20 minutes.
3	<p>Plasma source</p> <ul style="list-style-type: none"> • Remote plasma by inductive coupled plasma source • Distance to the bottom of the ICP coil in the range > 20 cm • ICP type: helical • Generator with directly coupled automatic matching with vacuum capacitors • Power ≤ 300 W, optionally upgradable to 600 W • RF power source 13.56MHz and automatic tuning • Matching unit capacitor positions selectable as process parameters • Ability to run plasma down to 10 mTorr
4	<p>Substrate table (holder / lower electrode)</p> <ul style="list-style-type: none"> • Suitable for up to 200 mm wafer loading via loadlock, open-loading of the chamber also possible with no breaking of either gas or vapour delivery lines. • 30°C – 400°C electrode • Substrate table temperature uniformity < $\pm 2.0^\circ\text{C}$ @ 400°C • Substrate table temperature control < $\pm 1.0^\circ\text{C}$ • OPTIONAL biased electrode
5	<p>Precursor Handling (for solid/liquid precursors)</p> <ul style="list-style-type: none"> • Fast Swagelok ALD valves for each precursor that allow a valve open time of 10 ms. • Heated precursor lines • Precursor cabinet for up to at least 3 liquid or solid precursors and optionally upgradable to 6 in future • Precursor temp 30 - 200° C • H₂O pot and water vapour delivery system.
6	<p>Gases</p> <ul style="list-style-type: none"> • Gas Box, separately mounted for at least 6 MFC controlled gas lines for plasma gases

	<p>and thermal gas precursors (such as NH₃, N₂, H₂, Ar and O₂). Each gas can be diverted to be used as a plasma gas, a thermal gas directly into the chamber or can be diverted to the pump. All by fast ALD valves that allow a valve open time of 10 ms.</p> <ul style="list-style-type: none"> • Fitted with at least 5 gases: NH₃, N₂, H₂, Ar and O₂. • Optional Ozone generator and destruction unit fully integrated into the software.
7	<p>Process Control</p> <ul style="list-style-type: none"> • Swagelok ALD valves temperature controlled up to 200°C • ALD valves controlled to minimum 10ms +/-1ms resolution • 150ms (open to close time) rapid automatic pressure controller • Argon bubbler mass flow controller coupled to rapid divert system for short bubbling and purging, including a divert into the foreline (chamber exhaust) • Auto leak and MFC check to easily check leak rate of chamber and connections and MFC functioning.
8	<p>Pumping configuration</p> <ul style="list-style-type: none"> • Heated pumping line • Corrosive compatible magnetic bearing turbomolecular pump of sufficient pumping speed • Dry Pump with with sufficient pumping speed, chemical series
9	<p>Vacuum loadlock</p> <ul style="list-style-type: none"> • Vacuum loadlock with inter-chamber valve • Suitable independent dry pump • On starting a process request from the PC, the wafer should be automatically loaded for processing and returned to the loadlock and left under vacuum until the user is ready to retrieve it. Then manually the loadlock vented and lid opened for unloading of the wafer.
10	<p>Log files</p> <ul style="list-style-type: none"> • Should have a Graphical display of any parameter • Able to load in multiple steps and parameters • Able to graph parameters in various ways – as measured value, measured value and set value, set value – measured value, derivative of measured value, set value bands with measured value. • Ability to display alarms and alerts associated with recipe steps loaded
11	<p>Installation and commissioning</p> <ul style="list-style-type: none"> • The system shall be installed / commissioned at customer site. • At least 3 members should be trained during installation at IIT Madras • The system shall conform to the Indian power supply standards, i.e. 230 V ± 5%, 50Hz, Single Phase or 400 V ± 5%, 50Hz, 3-Phase • The following acceptance criterion should be demonstrated after installation

Material	Plasma Al ₂ O ₃	Thermal Al ₂ O ₃
Precursor	TMA	TMA
Co-reactant	O ₂ plasma	H ₂ O thermal
Deposition temperature	25 °C– 400°C	120°C – 400°C
Thickness uniformity over 200 mm diameter	< ±2.0%	< ±2.0%
Refractive Index @ 632.8nm	1.62 (120°C)	1.64 (300°C)

12 Gas Lines and Piping

On-site gas line piping for all required gases shall be the responsibility of the supplier. The piping costs from our existing gas bank to system must be quoted. The utility area (where the gas cylinders are kept) will be within 18 meters from the equipment.

The supplier must ensure a completely safe and fool-proof mechanism for supply of inert as well as process gases that may be highly corrosive, flammable and hazardous in nature from existing source to till system. Hence, the work has to be handled only by an experienced vendor/sub-vendor. The vendor entrusted to take up this work should submit full contact details of customers for whom they have completed similar work during the past 5 years.

It will also be the responsibility of the vendor to test, validate and demonstrate the installed gas supply system for various parameters such as pressure decay (0 psi in 24 hours), He leak test (less than 1×10^{-9} Litre/sec), trace moisture and oxygen (below 1 ppm), particle tests (less than 10 particles of 0.1µm size), etc.

Following is a summary of requirement of gas piping. Any other requirement for ensuring safe operation may be brought out in the technical bid and the same may be quoted in the price bid.

Note:- Purchase Order will only be issued once scope of work [piping and instrumentation diagram/drawing (P&ID)] is agreed. The quote must include piping length up to 18 meters per process gas line, per inert gas line, per water line, per exhaust line, per CDA line. Unit costs for lengths required above 18 meters to be provided, in case additional length is required.

Before finalizing Purchase Order, vendor must visit us for site inspection and finalize P&ID, and same must be agreed and signed by both parties.

Tubing Material / Type:

- 1/2" × 1/4" SS316L, electro-polished, coaxial Tube, 10µin Ra max. tubing for corrosive gases such as NH₃
- 1/4" OD × 0.035" WT Seamless EP tube, SS316L, 10µin Ra max tubing for flammable and inert gases, such as pure N₂, H₂, Ar and O₂,
- OD as required by WT Seamless BA tube, SS316L, 10µin Ra Max. tubing for compressed dry air and water, GN2 .

	<p><u>Water Tubing, CDA and GN2 distribution</u></p> <ul style="list-style-type: none"> • Complete water, CDA & GN2 distribution as required by system, vendor must consider necessary number of valves regulators required for system. CDA and GN2 tapings to be taken from existing headers and all required chillers to be supplied along with system. <p><u>Exhaust System</u></p> <ul style="list-style-type: none"> • Complete Exhaust ducting interconnecting all tools outlet, and pumps outlet with appropriate dampers to our Scrubber and from Scrubber to our existing exhaust header (Total length of approximately 20 meters) • MOC OF DUCT, nuts and bolts must be SS304, minimum 2 mm thickness or higher.
13	<p>Warranty</p> <ul style="list-style-type: none"> • Standard warranty for one year and extended warranty for two years as optional • Standard warranty will include <ul style="list-style-type: none"> ○ Helpdesk support within Normal office hours Mon-Fri. ○ Response time typically within 24 hours ○ Team Viewer support (requires remote customer access and loaded software). ○ Engineer response to site based on availability (travel & expenses included) ○ Response time by OEM engineer (not agent) max 3 working days ○ Spare parts supplied, subject to availability. ○ Replacement or repair of all parts within standard operating conditions. Parts include items such as pumps, generators, chillers, substrate handler, elevators and handlers, MFCs, PCs, end point detectors, gauges and valves.
14	<p>Documentation</p> <ul style="list-style-type: none"> • To be provided with the bid quotation: <ul style="list-style-type: none"> ○ ISO9001 quality certification ○ CE marking confirmation ○ Installation documentation • To be provided with the system: <ul style="list-style-type: none"> ○ Operation and maintenance Manuals on CD, and OEM manuals.
15	<p>The supplier</p> <ul style="list-style-type: none"> • The bidder must confirm that it has its own clean room with systems of the quoted type installed there. • The suppliers must have supplied at least two systems of the same model in India. • Bidder shall provide list of at least five customers (India and abroad) along with email addresses, where the similar system has already been installed as part of technical bid • Spare parts must be available for min 7 years ex stock Asia