



INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

MATERIALS MANAGEMENT DIVISION

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**SPECIFICATIONS OF ATOMIC LAYER DEPOSITION SYSTEM**

No.	SPECIFICATIONS		Remarks
<b>1</b>	<b>Atomic layer Deposition system is required for deposition of following materials</b>		
<b>1.1</b>	The system should be capable for depositing : 1. High-k dielectrics such as Al <sub>2</sub> O <sub>3</sub> and HfO <sub>2</sub> , with thicknesses of up to 50 nm		
<b>2</b>	<b>Deposition Chamber</b>		
<b>2.1</b>	Size	System should be capable of carrying out deposition over up to 4" (100 mm) wafers and also on small pieces of arbitrary sizes and shapes. Conformal deposition on high aspect-ratio 3D surface, up to 6 mm tall must be possible.	
<b>2.2</b>	Material of construction	Chamber material should be compatible with process gases required for depositing films and should be mentioned with the technical bid.	
<b>2.3</b>	Chamber Design	Chamber design should be flow-optimized, and allow uniform deposition over up to 4" wafers and quick precursor purging.	
<b>2.4</b>	Chamber Seals	Should be rated for continuous operation in presence of precursor gases and their decomposition by-products at $\geq 325^{\circ}\text{C}$ .	
<b>3</b>	<b>Substrate Heating</b>		
<b>3.1</b>	Substrate Heating	The substrate heater design should allow achieving $325^{\circ}\text{C}$ or higher, over 4" wafer, while simultaneously maintaining $\leq 60^{\circ}\text{C}$ on outer walls of the chamber. The maximum substrate temperature should be achieved within 20 min or less, and with an overshoot $\leq 1\%$ .	
<b>3.2</b>	Substrate Accuracy	$\leq \pm 1^{\circ}\text{C}$	
<b>3.3</b>	Temp. variation	$\leq \pm 2^{\circ}\text{C}$ over 4" (100 mm)	
<b>4</b>	<b>Precursor Sources and Precursor Delivery</b>		
<b>4.1</b>	Precursors	<ul style="list-style-type: none"> <li>The system should be provided with 5 or more precursor bottles, at least 2 of which are heated (for low vapor pressure solids/liquids), and at least 2 of the remaining should be able to handle high vapour pressure solids/liquids.</li> <li>For the heated sources, temperatures of <math>140^{\circ}\text{C}</math> or higher should be achievable, with <math>\pm 2^{\circ}\text{C}</math> accuracy.</li> <li>Precursor bottles should be of 50 ml capacity or more, and made of high-quality stainless steel, with VCR connections.</li> <li>List of all precursors required for the deposition of materials as in 1.1 along with the purity should be mentioned.</li> <li>All necessary safety arrangement for handling organo-metallic precursors should be in-built in the system</li> </ul>	
<b>4.2</b>	Gas lines	<p>Necessary gas lines for controlled delivery of precursors and carrier/dilution gases should be provided as per following specifications:</p> <ul style="list-style-type: none"> <li>All gas lines should be Swagelok electropolished stainless steel tubes.</li> <li>Connections of components should be metal sealed Swagelok VCR fittings, and joints should be orbital welded</li> <li>Metal-sealed MFCs should be provided for corrosive/reactive gases</li> <li>All MFCs should be capable of gas flow rate of 5 – 100 SCCM</li> <li>Gas manifold should support heated carrier gas distribution to all ALD lines, and complete purging of the gas lines.</li> <li>It should be possible to heat the gas manifold, precursor lines, and ALD valves up to <math>200^{\circ}\text{C}</math>, with PID control.</li> <li>Precursor pulsing valves should be pneumatic high speed (<math>\leq 20</math> ms), high temperature (<math>200^{\circ}\text{C}</math>) valves, with continuous purge during operation.</li> <li>Valves and components near the chamber should be rated for <math>\geq 200^{\circ}\text{C}</math></li> <li>3-way ALD valves for mixing precursor vapor with carrier gas should be</li> </ul>	

		provided.	
<b>5</b>	<b>Vacuum</b>		
<b>5.1</b>	Pumping System	<ul style="list-style-type: none"> <li>Dual stage, Fomblin PFPE oil sealed, rotary vane pump with magnetic coupling, with at least 200 LPM capacity, from reputed manufacturers like Edwards, Pfeiffer etc.</li> <li>Automatic system venting with pneumatic gate valve and controlled back fill of N<sub>2</sub> gas should be possible.</li> <li>Venting time should not be longer than 10 min.</li> <li>In-line large surface area trap with active media to trap unreacted metal-organic chemicals should be provided.</li> <li>Suitable vacuum gauge should be provided for measurement and monitoring of the reactor pressure in real time.</li> <li>System should have provision for manual pumping and venting, along with process-controller controlled operation.</li> </ul>	
<b>6</b>	<b>Process Controller</b>		
<b>6.1</b>	<p>Process controllers with latest version of licensed control software, OS and latest hardware configuration and necessary interface cards and ports for controlling each and every step of deposition is required. Separate controller if required for any component should also be provided. It should be capable of:</p> <ul style="list-style-type: none"> <li>Controlling the complete deposition system and its subsystems</li> <li>Read-display-store the data generated, including but not limited to setpoints &amp; process values, status of different components.</li> <li>Storing and recalling experimental deposition parameters</li> </ul>		
<b>7</b>	<b>Consumables, Spares &amp; Tools</b>		
<b>7.1</b>	Consumables:	<p>(a) All necessary consumables and spares for installation, calibration, initial testing and demonstration of system including precursors, gases, substrates (4" diameter), SiO<sub>2</sub> coated Si samples etc. have to be arranged by the equipment supplier.</p> <p>(b) A list of same is to be provided along with the technical bid</p>	
<b>7.2</b>	Spare Parts Kit	<p>(a) Firm has to guarantee system &amp; spares support for 10 years</p> <p>(b) Set of frequently needed spare parts should be quoted separately.</p>	
<b>7.3</b>	Tool Kit	Tools kit for mounting and demounting of samples, replacement of consumables and regular maintenance of system and subsystem should be provided	
<b>8</b>	<b>Acceptance, Training, Installation &amp; Demonstration</b>		
<b>8.1</b>	Criteria for acceptance of techno-commercial bid	<p>(a) It should completely meet our techno-commercial requirements</p> <p>(b) Firm has to deposit ~ 10 nm Al<sub>2</sub>O<sub>3</sub> in a similar system and provide samples with characterization reports.</p> <p>(c) Firm has to provide details of at least three users where similar system has been supplied.</p> <p>(d) Firm has to obtain export license from applicable authorities</p>	
<b>8.2</b>	Available power	The entire system and all its sub-systems and accessories should work at 50 Hz ± 2%, {415 V±10%, 3ϕ} OR {220 V±10%, 1ϕ} as per available at installation site.	
<b>8.3</b>	Installation	<p>(a) The system has to be installed and commissioned, including all necessary interconnections and interfacing to the outer world (power, water, pump, gases etc.) is to be done by supplier, followed by demonstration of system performance.</p> <p>(b) Meeting shielding/EMI/EMC requirements of the system is the responsibility of supplier.</p>	
<b>8.4</b>	Performance Demonstration and acceptance	<p>The following need to be demonstrated at our premises</p> <p>Demonstration of performance of all sub-systems</p> <p>(a) Deposition of required materials:</p> <ul style="list-style-type: none"> <li>High-k dielectrics (Al<sub>2</sub>O<sub>3</sub>,) : 5 nm thickness variation ≤ 20% over 3"</li> </ul>	
<b>9</b>	<b>Safety, Documentation, Technical Support, Compliance, Warranty &amp; Payment Terms</b>		
<b>9.1</b>	Safety	<p>(a) All necessary alarms and interlocks for equipment and operator safety, and emergency off button should be provided.</p> <p>(b) Provision for system shutdown in event of failure to be provided.</p>	
<b>9.2</b>	Compliance	The system should be compliant with SEMI S2-1102, CE, EMI/EMC guidelines or equivalent international standards.	
<b>9.3</b>	Documents to be	Following documents are to be submitted with technical bid:	

	<i>submitted with technical bid</i>	<ul style="list-style-type: none"> <li>(a) Compliance statement for each item of this document</li> <li>(b) Detailed and complete system specification with system images</li> <li>(c) Brochures, application notes and operation manual</li> <li>(d) Necessary reference data and curves for physical and optical measurements carried out over at least two required films deposited in a similar system</li> <li>(e) Chamber drawing and material of construction, chamber seal and its compatibility certificate with the precursor gases and their decomposition by-products at <math>\geq 300^{\circ}\text{C}</math>.</li> <li>(f) Gas path schematic indicating precursor sources, carrier gases, regulators, MFCs, pressure controllers, valves etc.</li> <li>(g) Software installation manual and tutorial</li> <li>(h) Replacement schedule of system components, consumables etc.</li> <li>(i) Safety features and list of interlocks</li> <li>(j) List of spare parts provided in the spare part kit.</li> <li>(k) Calibration schedule with description of calibration procedure. <b>(Calibration charges pre &amp; post warranty is to be included in price bid)</b></li> <li>(l) Complete list of spare parts and consumables <b>(Prices of spare parts and consumables is to be included in price bid)</b></li> <li>(m) Facilities required at site prior-to and during installation.</li> <li>(n) Contact details of three users working on similar system</li> </ul>	
<b>9.4</b>	<i>Documents to be shipped with equipment</i>	<ul style="list-style-type: none"> <li>(a) New machine certificate issued by original manufacturer</li> <li>(b) Calibration certificate traceable to relevant international standards</li> <li>(c) SEMI-S2-1102, CE &amp; EMI/EMC compliance certificate</li> <li>(d) Gas path and electrical schematics</li> <li>(e) One set of all operation, maintenance and service manuals (soft copy)</li> </ul>	
<b>9.5</b>	<i>Technical Support</i>	<ul style="list-style-type: none"> <li>(a) Technical support for both maintenance, trouble-shooting, and recipe development should be available locally, and within 72 hours.</li> </ul>	
<b>9.6</b>	<i>Warranty</i>	<ul style="list-style-type: none"> <li>(b) ONE Year standard + TWO years extended parts &amp; labour comprehensive warranty including calibration charges, from the day of successful demonstration.</li> <li>(c) Free software upgrades to be provided during warranty period</li> <li>(d) Response time during warranty should not be more than 48 hours.</li> </ul>	