Annexure-1

Technical Specifications of

'Plasma Assisted RF, DC Magnetron Sputtering (PARMS) unit'

Sl. No.	Sub-components description
1	**Vacuum chamber design:** o Fully RF shielded, High Grade Stainless Steel, electro-polished body, box-type, SS304 maximum of 60 liters with dimensions less than or equal to 400 mm x 400 mm. o A vacuum port for turbo-molecular pump at the backside of chamber with automatic valve operation. o Protective liners set: Set liners for protection of the chamber walls against coating. Set liners will be easy removable and made of thin mirror finished stainless steel sheet. o Top plate should have support for connecting minimum 4no's of magnetron sources arranged in confocal and/or co-planar; gas inlet port, power feed through ports, source shutter on top of three targets. Minimum of three additional ports with Blanks for future up gradation on process chamber. o Two view ports of circa 90mm diameter to monitor sputtering process and plasma and view ports across the chamber should be provided. o Bottom plate should have appropriate ports/feed through for substrate holder with rotation, heater, thermocouple etc. o Chamber should have provision to upgrade 6-inch size load-lock facility. o The chamber should have provision to upgrade a transfer chamber/ an E-Beam & thermal Evaporation System to make a Linear Cluster Tool. o The entire fabrication must adhere to international Vacuum Welding Standards, electrochemically polished chamber inner surface for low out gassing rate. All the components, sub-assemblies and final unit must be leak tested using Helium Mass Spectrometer Leak Detector to Maximum allowable leak rate < 1 X 10^{-9} mbar Lt/sec Helium.
2	**System dimensions and support structure:** o Cleanroom compatible, ISO 5 Class 100 standard, sputter tool and all necessary supportive documents on cleanroom compatibility must be submitted along with the technical bid. o Low-foot print area of ~ 60 cm x 120 cm with powder coated rack to place power supplies, other electrical systems.
3	**Substrate holder with rotation and Z-shift:** o Substrate holder material of construction (MoC) Inconel to position minimum size of 10 cm x 10 cm. Two numbers of each type of substrate holder as per customized design should be provided. o The substrate holder capable to handle 6" wafer with rotation fixed at the center of bottom plate with variable speed (1–20 rpm). o Target to substrate distance should be variable ~ from 50 to 100 mm (z-shift) o Fully automated DC biasing to substrate should be provided. o Fully automated substrate cleaning using RF bias should be provided.
4	**Substrate heating:** o Variable Substrate temperature control from room temperature to 600 ºC during deposition, accuracy of ±1ºC of suitable thermocouple with Digital PID Controller substrate temperature should be able to control to up to 600 ºC on the substrate during sputter deposition process and set temperature must be

	stable with ≤ 1 ºC for at least minimum 5 hours. o All necessary support documents on precision and control of temperature on the substrate must be included in the technical bid.
5	**Magnetron sources:** o Minimum two numbers of reputed make, flexi-head, indirect water-cooled, RF/DC compatible, circular Magnetron Sources of 3 inch size, mounted on the top plate, sputter-down, co-planar/confocal arrangement capable to sputter from target thickness of 1/64" to ¼ inch. o Minimum one number of reputed make, flexi-head, indirect water-cooled, RF/DC compatible, circular Magnetron Sources of 2 inch size, mounted on the top plate, sputter-down, co-planar arrangement capable to sputter from target thickness of from 1/64" to ¼ inch. o Three Magnetron Shutters directly mounted on the Magnetrons & made up of SS304L (or superior) should be offered as standard; Shutter should be of pneumatic operation; Shutter shall be easily removable for cleaning. o All magnetrons should be UHV compatible. o Shutter assembly to properly shield between source and substrate. o Cross contamination shields for isolation of each magnetron should be provided. o Capability to perform co-sputtering deposition between any two magnetrons controlled through PC. o Two sets of covers (both target clamp ring and outer shield of cathode) for each magnetron. o Shutter assembly to fully cover 6" substrate from the source, during pre-sputtering. o Magnetrons should have capability for a long deposition run at a given process pressure under a constant power over a defined time and guarantee a uniformity figure of 300 nm Al at 0.5 A/s, Ar gas at a process pressure of 1.5 mbar, 6" wafer, within ± 2.5% non-uniformity. Support data must be included in the technical bid (as well as should be demonstrated at the installation site).
6	**RF and DC Power supplies:** o 1 number of DC power supply, of reputed make, 800 W or above, having tight regulation ≤ 0.2%, variable ramp and 0.1% resolution with digital displays or interfaced with control panel. o 2numbersof RF Power Generator of 300 W or above, of reputed make, nominal frequency of 13.56 MHz with auto matching network load impedance of 50 Ω. o Display for power delivered; control Mode Current, Voltage or Power set point. o One number of fully automated 4-way RF selector switch for changing RF or DC power between any of the three magnetrons, and/or substrate for plasma etching or DC biasing.
7	**Gas distribution system:** o A Gas Manifold fabricated out of SS, three numbers of reputed make MFC 2-50 sccm for Ar and 2-10 sccm for Nitrogen & Oxygen with filters, valves and inlet solenoid valve. o Manifold to be evacuated when not in use to avoid memory effects. o A solenoid operated isolation Valve for N_2 gas for fast venting of the chamber.

8	**Vacuum pumping system:** o Reputed make dry scroll pump having displacement capacity of minimum 15 m^3/h. o Foreline trap with heater at the inlet, reputed make, water-cooled turbo molecular pump having the pumping speed of at least 400ltrs/sec, vent valve and connecting cables, a fully automated PLC Controlled high vacuum system with necessary valve. o Vacuum pumping lines made out of SS-304 with bellow adaptors, reputed make one wide range suitable gauge or Microvac Gauge, motorized throttle valve of suitable size with controller taking its input the fast response capacitance manometer at suitable position to maintain quickly the required partial pressure of Argon inside the chamber to carry out the Sputtering operation. o Base pressure: ultimate vacuum of at least 5 x 10^{-7}mbar within three hours of start of system, in clean, cold, empty degassed chamber after back filling the chamber with pure and dry Nitrogen. o All the components, sub-assemblies and final unit must be leak tested.
9	**High resolution pressure control:** o Automatic pressure control via PID feedback loop operated in response to high-resolution chamber pressure measurements from a high-accuracy 0.1 mbar full scale capacitance manometer. o All necessary support documents for high-resolution of ±0.1 mbar pressure control from the set value during the deposition of at least 8 hrs must be included in the technical bid. o System software must automatically adjust MFC flow rates (including to a fixed, user-defined ratio, if more than one MFC is being operated simultaneously) to achieve the desired chamber pressure. Pressure control resolution to 0.1 mbar. o Upstream pressure control, which should be able to control the process pressure to ±0.1 mbar from the set process pressure throughout the sputtering cycle and temperature ramps for a minimum of 8 hrs. o 100mT temperature compensated capacitance manometer pressure transducer for accurate Process Pressure Control is a must.
10	**Thin film deposition and quality:** o High precision control on growth of thin film deposition using high-resolution pressure control from few nm to few µm sputtering from single target or co-sputtering from two different targets. Film should have uniformity ≤ 2.5 % variation in film thickness on edge-to-edge 6-inch substrate size. o All necessary support documents for uniformity at different substrate sizes from 4 to 6 inch must be included in the technical bid. o Recipe for standard metals and non-metals deposition. o Must have capability of low vacuum thin film deposition of minimum 1.5 mbar for standard metals such as Al, Cu and Ti. Support data must be provided in the technical bid.
11	**Auto/manual thin film deposition:** o PC interface to the PLC and PLC based vacuum controller for complete automation of vacuum pumping with fully automatic and a provision for manual control. High resolution colour touchscreen HMI with purpose-designed easy-to-use, powerful software to enable deposition in either manual

	or automatic (i.e., per user-defined recipes) control modes. System control via industrial-grade, high-stability PLC electronics. o System should have USB and/or Ethernet connections for servicing/diagnostics and data logging/download during use from PC/laptop.
12	**Safety interlocks:** o Water, low vacuum, high-vacuum, power supply connections and all necessary safety interlocks must be provided. o An emergency stop button should be provided to maintain the process chamber under vacuum in case of emergency and should be able to revert to safe state in event of a power cut, ready for easy power restart.
13	**Warranty:** o Standard warranty for one year and extended warranty for two years as optional. o Vendor shall commit to provide spares and support for 05 years after expiry of warranty period.
14	**Operating manual:** o Both electronic and hardcopy o The documentation/manual shall include all drawings, schematics, spares parts catalogues and also sub-vendor's manuals.
15	**Fast Vent Module:** o Fast vent option should allow the process chamber to vent within 6~8 minutes.
16	o The system shall be installed / commissioned at customer site. The quotation shall be inclusive of all charges, if any, for installation and commissioning of the equipment by the vendor. o Extensive operation and maintenance training of two persons for one week at the customer site after the installation should be included. o Vendor to provide complete clean room compatible documentation/manuals soft copy/ hard copy for the systems. o Training at least 3 members during installation at IIT Madras o The system shall conform to the Indian power supply standards, i.e. 230V ± 5%, 50Hz, Single Phase. o Vendor 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 the technical bid. o Only reputed original equipment manufacturer (OEM) should submit the tender. o Warranty Certificates from manufacturer for bought out items like Power Supplies, Vacuum Pumps with Serial Numbers will have to be provided along with system documentation.
17	**Chiller:** o A good chiller suitable for the sputter unit should be provided.
18	**Optional Items:** o The system and subsystems should have on-site upgradability with: o Film Thickness Monitor should be offered as upgrade. o Controller will be able to control the rate of deposition as well. o One additional 3” diameter magnetron source with necessary accessories. o A load-lock chamber, which could handle the substrates as described in the above technical specification. The transfer mechanism should be able to

	transfer one substrate of the size mentioned in the technical specifications or many smaller size substrates using a carrier. o A load-lock chamber equipped with RF Etch Facility to clean the substrate/s before transferring to the main chamber for deposition. o Vendor needs to confirm the suitability of the system offered to be able to upgrade these facilities on-site. o Vendor needs to provide User references where such upgrades have been carried out on-site.

Additional Requirements:

- OEM should have authorized service centre in India, functioning minimum for 10 years to provide repair, maintenance, calibration and upgradation facility (OEM should provide necessary service of operation certificate).

- The rate should be quoted for C.I.P Chennai.