	INDIAN INSTITUTE OF TECHNOLOGY BOMBAYMATERIALS MANAGEMENT DIVISION **Powai, Mumbai 400076.**

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Detailed Technical Specifications for Electron Beam Evaporator:

No.	SPECIFICATIONS	
	Evaporation system is required for deposition of following materials	
	The system should be capable for depositing single-layer and stacks of metals such as Aluminum, Gold, Palladium, Nickel, Titanium, Tungsten and Platinum on substrates of up to 100 mm diameter, as well as small and arbitrarily-shaped substrate pieces, with thickness variation ≤ ±3% (over 100 mm). The system should include the main deposition chamber, a fast-entry load-lock, suitable transfer mechanism, necessary vacuum pumps, valves, gauges, electron guns, thermal sources, power supplies, substrate fixture with active cooling mechanism, shutters, instrumentation and all necessary controls (Please see details below). The system should be operable in semi-automatic or fully manual mode.	
	Deposition Chamber	
	Size/ material/ design	The (main deposition) chamber should be made of non-magnetic 304 stainless steel, and provided with a suitable door. The chamber should be provided with at least two view ports, and three additional blank ports, sealed with blank flanges, for future expansion. The chamber should be provided with stainless steel liners for protection of the main chamber walls against metal deposition. These liners should be easily detachable/removable for periodic cleaning. The chamber should allow deposition of single-layer and stacks of metals such as Aluminum, Gold, Palladium, Nickel, Titanium, Tungsten and Platinum on substrates of up to 100 mm diameter, as well as small and arbitrarily-shaped substrate pieces, with thickness variation ≤ ±3% (over 100 mm).
	Vacuum	The chamber should be leak tested for < 2 x 10^{-9} Torr, with std l/sec for Helium The chamber base pressure should be less than 1e-7 mbar. The base vacuum must be reached in 3.5 hours or less.
	Chamber Seals	OFHC copper gaskets should be provided for large conflat flanges which will need infrequent opening. All other ports and flanges should be provided with sufficiently heat, chemical and UV resistant synthetic elastomer o-rings.
	Load-lock chamber	
	Design/ Material	The load-lock chamber should be made of non-magnetic stainless steel 304. It should be compatible in design with the deposition chamber. In particular, it should allow loading and transfer (to the deposition chamber) of substrates with up to 100 mm diameter (one

		at a time), as well as, small and arbitrarily-shaped substrate pieces, using a suitable linear transfer-arm/probe. The gate valve between the load-lock & the deposition chamber should be sourced from reputed manufacturers (VAT, Pfeiffer or equivalent) should be interlocked for fool-proof operation, but should also be manually operable (by bypassing the interlock).
	Vacuum and Pumping	The load-lock should be able to reach a base pressure of $5x10^{-7}$ mbar or lower. The load-lock should be provided with a suitable turbomolecular pump, from a reputed manufacturer (Leybold, Pfeiffer, Varian or equivalent)
	Provision for O_2 plasma etching	The load-lock should have the provision of O_2 plasma ashing. Necessary isolated bias stage, RF power supply, mass flow controllers from reputed manufacturers (Kurt J Lesker, Bronkhorst or equivalent) for flow of Argon and Oxygen, mechanism for transfer of substrates as mentioned, to/from the linear transfer probe to the stage, should be provided. O_2 plasma ashing should be possible at RF power of $\leq$ 30 W and up to $\geq$ 100 W. The gas flow, for both gases mentioned above, should be controllable from 5 sccm to 100 sccm. Provision to minimize the reflected RF power to less than 5 % of the total value should be possible, and display for both the forward power and the reflected power should be provided.
	Pumping System for the deposition chamber	
	Roughing pump	The system should have roughing dry scroll pump, procured from reputed manufacturers (ANESTA-IAWATA, Leybold, Varian, Edwards or equivalent) The pumping speed should be 10 m^3 /h or more and the lowest reachable pressure should be 8 X 10^{-3} mbar or lower. All necessary flanges, tubing, electrical cables, controllers, filters and other accessories should be quoted
	Turbo molecular pump	The high vacuum pumping should be provided by a turbo molecular pump procured from reputed manufacturers (Leybold, Varian, Edwards, Pfeiffer or equivalent) and providing a pumping speed of 400 liters/sec or better And/or A cryopump, procured from reputed manufacturers (CTI or equivalent) The ultimate vacuum in the deposition chamber should be 1 x E-7 mbar or better.
	Other details	The pumping system should be fully automatic and interlocked, but fully manual operation should also be possible A LN_2 Cold Finger should be incorporated in the deposition chamber, in order to improve the base vacuum of the system Vendor should furnish the details of the vacuum pumps, their make, pump-down time, etc. in the quotation.Interlocks for water, vacuum, gate-valve status, linear-probe position, high voltages and electron beam magnet status should be provided and displayed. It should be possible to bypass interlocks, when in trouble-shooting mode.

	Vacuum Gauges	
		Necessary vacuum gauges from reputed manufacturers (INFICON, Agilent, Edwards, Granville-Phillips or equivalent) should be provided for the deposition chamber and the load-lock chamber
	Evaporation Sources	
	Electron beam sources	One Electron Beam Gun (EBG), procured from reputed manufacturers (Telemark, Temescal or equivalent), 6 number of 7-cc pockets, a rotatable hearth, programmable XY sweep control, and 270^0 beam deflection option should be provided. The design should be such that the active electron beam source will bepositioned on-axis with substrate stage. The working distance should be 42 cm or more, ensuring deposition uniformity and no hardening of common photo- and electron-beam lithography resists, and minimizing radiation damage of the substrate. Both manual and remotely computer-controlled turret rotation options should be provided to allow for multi-layer deposition. Suitable EBG power supply from reputed manufacturers, offering better than ± 1% voltage / current regulation, should be provided. Safety interlocks for rear cover, water, vacuum and magnet should be provided. Power regulation should be possible on a hand-held remote control, such that simultaneous viewing of the target is possible.
	Thermal sources	Two box-type thermal evaporation sources, rated for a maximum current of 400 A or more should be provided. The source should be capable of accommodating spirals, baskets, filament and tungsten boats of standard lengths. A digital programmable DC power supply, providing variable current of up to 200A should be provided.
	Shutters	
	For Sources	Necessary number of pneumatically controlled shutters should be provided separately for the electron-beam and thermal sources. It should be possible to override the automatic mode and control the shutters in manual mode.
	For substrate	Suitable pneumatically controlled substrate shutter should also be provided. It should be possible to override the automatic mode and control the shutters in manual mode.
	Deposition rate controller and monitor	
		Water cooled Quartz-crystal-sensor-head-and-oscillator-based deposition monitor, which enables rapid measurement updates with superior resolution, with the following capabilities Thickness Display: 0.000 to 999.9 KA Rate Display: 0.0 to 999 A/sec should be provided.
	Substrate Stage	

		Substrate stage should allow deposition on arbitrarily-shaped small wafer pieces and full wafers of up to 100 mm diameter The substrate stage should provide provision for active cooling of the substrate/chip down to a temperature of 20 ℃ or lower. It should be possible to read the substrate temperature, before, during, and after the deposition. It should be possible to introduce high purity O_2, as process gas, in the close vicinity of the substrate stage, in a controlled manner. Process O_2 flow rate should be controlled by a mass flow controller, with range of 0 to 10 sccm. The gas-line should be fitted with a high-quality shut-off valve to ensure absolutely no gas flow after MFC is set to zero.
	List of spares and accessories to be provided	
	Spares	Door-seals (2), Base plate O-rings (1), Base plate blanking flange (1), base-plate blanking plug (1), All necessary copper gaskets (5 pcs of each type), electron beam filaments (5), quartz crystal sensor heads (10), and critical feedthroughs (1 of each type).
	Accessories	A chiller of the appropriate capacity required for substrate cooling, boats (50) and spirals (10) for thermal evaporation source, quartz-crystal-sensor test kit, electron-source service kit.7cc crucible liners (Boron Nitride, Alumina, Graphite and Vitreous Carbon over Graphite) 2 Nos each.
	Safety, Documentation, Technical Support, Compliance, Warranty & Payment Terms	
	CE Certifications	Should be provided for all parts
	User manuals	Should be provided for all components and the complete unit, in both soft and hard copies, during supply of the system
	Technical support	Should be available within India. Should be available within 24 hours, in case of emergencies.
	Spare parts	Spare parts support should be available for 10 years or more from the day of installation of the system.
	Process Demonstration	The process demonstration has to be carried out by the supplier, with consumables and utilities support provided by us (the user). Details of the process demonstration should be mentioned as a part of the technical bid, which should include verification of critical pre-deposition, deposition, and post-deposition parameters. The process demonstration should also include deposition of 10 nm of titanium, followed by 40 nm of aluminum, on a 2 " silicon wafer. Thickness uniformity specifications should be met.
	Pre-installation preparations	The technical bid should mention pre-installation preparations required from the user's side.
	Warranty	One-year comprehensive warranty, which includes parts, travel and labour, has to be provided from the date of successful installation and commissioning at customer's site. Software up-gradation, if any, has to be incorporated free of cost during the warranty period.
	References	The vendor should include references of at least 2 users from within India, and 1 user from abroad, who are currently using an electron beam evaporation system, with identical configuration.