INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

MATERIALS MANAGEMENT DIVISION

Powai, Mumbai 400076.

Ref. PR No. 1000052232 **RFx. No. 6100002692**

Technical Description: Spark Plasma Sintering system for sintering of sputtering targets

Item Description and Detailed Technical Specification				
Sr No	**Specification for 250kN Spark Plasma Sintering (SPS) equipment**		**Technical Compliance (Yes / No)**	**Additional Information (if any)**
1	**Pressure Capacity:** 5 kN to 250 kN			
2	**Furnace-cum-pressing chamber:**			
	i.	Cylindrical, double walled completely water-cooled frontloading type vacuum chamber		
	ii	Stainless steel AISI 321 or equivalent		
	iii	Inside dimension: Ø 390 mm x 470mm height		
	Iv	Max. mould dimensions: Ø 200mm x h 190 mm		
	V	Max. Sample size : 20mm - 80mm Ø		
	Vi	The Max. temp. at touchable surfaces < 45°C		
	Vii	Working Temperature : upto 2200°C		
	viii	Max. Temperature : 2400°C		
	Ix	Heating rate : 5 – 500 K/min		
	x	Ports for viewing and focusing pyrometer for temperature measurement.		
	xi	two additional blind flanges for installation of additional devices and gauges.		
	xii	An additional glass window for positioning lamp from outside the chamber for illumination of chamber interior.		
3	**Vacuum pumping system**			
	i	A two stage direct driven rotary vane type mechanical pump, make Leybold or equivalent		
	ii	Pumping Speed : 25 m^3/h		
	Iii	Ultimate vacuum level in cold furnace : $5x10^{-2}$ mbar.		
	iv	Overall leak rate: < 5×10^{-2} mbar-liters/second.		

	v	Automatic operated roughing valve, plumbing system to connect chamber to the pump, O rings and seals.		
	vi	Safety valve for releasing the pressure in case of emergency and emergency shut off switch.		
	vii	Chamber pressure control +20 - +60 mbar (relative pressure)		
	viii	Leybold CF/KF or compatible vacuum flanges.		
	Ix	Standard fittings and flexible SS hoses for vacuum connection.		
4	**Pressing system:**			
	i	Pressing Force : 5kN – 250 kN		
	ii	Max. Pressing Force : 250 kN.		
	iii	Displacement transducer, absolute and relative path, ds/dt-signal 0-100 mm/min., accuracy 3 µm		
	iv	The pressing frame with 4 rigid posts for ram alignment.		
	v	Water cooling for the ram with stand the sintering temperature of 2200°C		
	vi	IR pyrometer for measurement of temperature measuring range 100- 2550°C.		
	vii	Servo-hydraulically and monitored manually/ programmable.		
	Viii	Total ram displacement under pressure: 0 - 100mm		
	ix	Ram displacement speed – upto 2 mm/s at maximum force.		
	x	Pressure gauge should be provided for observing		
	xi	Pressure gauge for observing instantaneous compaction pressure.		
5	**Process gas system:**			
	i	Process gases used: Argon, Nitrogen and Helium		
	ii	Gas dispersing and pressure regulation should be mass flow controller. All appropriate inter-component connecting plumbing has to be provided.		

	iii	All the gas inlet system components, valves, mass flow controllers should be constructed from SS (AIS- 304) grade and leak tested with leak rate $<10^{-3}$ mbar-litres/sec.		
	iv	Automatic chamber pressure control		

6	**Heating power supply for furnace**			
	I	Input power supply: 3 phase 400V AC ±10%, 50 Hz, 78KVA		
	ii	Output DC Voltage: 0- 8V or higher		
	iii	Output DC Pulse current: Max. 7000 A or more		
	iv	Maximum continuous power: 56kW		
	v	Pulsed DC (programmable/ manually adjustable ON and OFF time.		
	vi	System should have Modular inverter power supply		
	vii	Pulse duration (ON): 1-999ms Programmable		
	iix	Pause duration(OFF) : 0-999ms		
	ix	Range of temperature: programmable/manually selectable from room temperature to 2220°C.		
	x	System should have current and voltage display		
	xi	Heating rate variable up to 500 K/min.		
	xii	Maximum temperature variation across sample: +/- 5ºC or less		
7	**Water cooling system** A chilled water circulating system connection to different parts.			
	i	Inlet temperature should be 20 - 30°C +/-1%.		
	ii	Water flow rate: 4,5 m^3/h (50-75l/min)		
	iii	Water pressure: Inlet pressure: 4 - 5 bar g Return pressure: <0.5 bar g		
	iv	Temperature and flow rate indicators for visual monitoring of water temperature and pressure.		
	v.	Control adjustment for temperature and manual valves for flow adjustment of water circuits.		
	vi	Safety flow interlock sensors on critical water circuits – protection in low-flow and high-flow conditions.		
	vii	Water manifolds – one for supply and one for discharge.		
	Cooling water circulator/Chiller specifications			
	i	Input power supply: 3 phase 415V AC, 50 Hz, 26A		

	ii	Cooling capacity – 30 kW		
	iii	Refrigerating media R407C		
	iv	Temperature outlet: 22°C ± 2°C		
	v	Water flow rate: 4.5m^3/h/50-75 liters/min		
	vi	Water pressure : 4 – 5 bar g		
	vii	Water tank: SS (AISI – 304)		
	viii	Tank capacity : 200 liters		
	ix	Max. ambient temperature : 38°C		
9	**Control instrumentation system configuration** **High performance industrial process control system with infrared touch screen operation SIEMENS/STANGE or substantially equivalent.**			
	i	Power supply – 24V DC +/- 20%		
	ii	Foil front panel, front panel protection class IP 65		
	iii	Foil keyboard with 34 keys		
	iv	32 bit Pentium based processor 600 MHz		
	v	10.4“ TFT display, VGA 640x480 Pixel resolution		
	vi	SRAM 32 kByte battery backed, 256 MB RAM.		
	vii	256 MB Compact Flash		
	viii	Interfaces COM (RS232), Ethernet (100 MBit), PS/2 (PC keyboard), VGA		
	ix	Real Time Operating System VxWorks, for extremely high operating safety		
	x	Freely programmable multitasking PLC according to IEC 61131 under windows or substantially equivalent		
	xi	Softkey control for the functional parameter settings.		

10	**PC for data acquisition and process**			
	i	The complete system should have all its operations controlled manually as well as through a work-station PC with 21” flat screen, with the state of art latest configuration such that all operations and data acquisitions can be done without any hindrance.		
	ii	The configuration of the PC should be adapted to the process control system. It should be connected online by Ethernet interface.		
	iii	Suitable process control software for - data evaluation and recipes management system, Free programmable recipes, Manual and automatic operation via visualization		

		screen, Cycle and historical trend display, Status display of all relevant system components, Alarm display and alarm storage The software should be pre-installed in the above computer system			
	iv	Industrial router mbNET for remote maintenance support			
	v	All software should be of licensed version and backup CDs also to be provided.			
11	**Temperature Measurement**				
	i	IR pyrometer to measure temp. of the chamber from 250 - 2500°C	1 No		
	ii	K type thermocouples for the measurement & control of pressing punches on the surface	2 Nos		
	iii	K type thermocouple with flexible arrangement on the mould for temperature measurement & control	1 No		
12	**<u>Moulds</u>** 1. 1 set of mould for sample Ø10mm, material high dense graphite, max. temperature 2200ºC. including connection pieces and centering 2. 1 set of mould for sample Ø20mm, material high dense graphite, max. temperature 2200ºC. including connection pieces and centering 3. 3 set of mould for sample Ø50mm, material high dense graphite, max. temperature 2200ºC. including connection pieces and centering 4. 3 set of mould for sample Ø75 mm, material high dense graphite including connection pieces and centering		1 No		

		5. 1 set of mould for sample Ø80mm, material high dense graphite, max. temperature 1600ºC. including connection pieces and centering .			
13	Recommended Spares and consumables:		Thermocouple K-type 2 nos. required for the SPS, Filter wool for dust separator- 3 nos., fuses, lamps, carbon filters and carbon felt – 3 nos. each.		
14	**Other Requirements:**				
	i	The vendor should have supplied at least 3 or more spark plasma sintering units to an organization in India. At least two international references also should be provided **(proof to be attached).**			
	ii	Warranty: Warranty of 1 year from the date of installation.			