Multi-zone Thermal Chemical Vapor deposition (CVD) System-H

Technical specifications for Multi-zone thermal Chemical Vapor Deposition (CVD) system to grow various 2D materials including, Graphene, TMDs (MoS2, MoSe2, WS2, WSe2)

The Multi zone CVD system should have the following specifications:

1	Furnaces	Three number movable split tube furnaces mounted on chrome plated stainless steel rails. All three furnaces should be powered by Kanthal A-1 elements
2	Hot Zone Length	Furnace 1: 200mm, Furnace 2: 200mm Furnace 3 : 75mm
3	Uniform Hot Zone (+/- 5 ^{o}C)	Furnace 1: 70mm, Furnace 2: 70mm Furnace 3: 25mm
4	Hot Zone Tube of Quartz	Outer Quartz Tube: Outer Dia: 60mm, Inner Dia: 55mm, Length: 1700mm Inner Quartz Tube: Outer Dia: 45mm, Inner Dia: 40mm, Length: 600mm
5	Furnace Dimension	Furnace 1: Length- 350mm, WxH- 350x350mm Furnace 2: Length- 350mm, WxH- 350x350mm Furnace 3: Length- 150mm, WxH- 150x250mm
6	Furnace Working Temperature	Furnace 1: 1200 ^{o}C Furnace 2: 1200 ^{o}C Furnace 3: 600 ^{o}C
7	Stand and Control Panel	Furnace should be installed on a table with control panel and PLC touch-screen below the furnace table
8	Position of MFC	Below the furnace table
9	Movement of furnace on rails	Furnaces to be manually moved from side to side with maximum sliding distance of 300mm. Total length of sliding rail is 1300 mm. Three slide stopping clamps are in place to hold the position of furnace.
11	Heating rate of furnaces	Upto 20 ^{o}C/Min

VOLTAGE AND UTILITY REQUIREMENTS		
1	Power Supply Panel	Through a separate control panel
2	Voltage Rating	220V, 50/60Hz, 3Φ, 4-wire, 30A
3	Water for chiller	2-3kgf/cm2, ½" tube
4	Weight	200 kg
5	Footprint	2.5m (W) x 1.50m (H) x 0.80m (D)

INSULATION		
1	Insulation type for continuous working at 1100 C	All vacuum formed latest technology fiber board insulation which is light weight and heats the furnace with lowest energy consumption
2	Number of insulation layers	2
3	Hot face insulation tem rating (^{o}C)	1400

HEATING ELEMENTS AND THERMOCOUPLE		
1	Heating element type	Open type Kanthal A-1 supported on Alumina tube and partially 1/3 rd embedded in Fiber boards
2	Thermocouple type and number	Calibrated by NABL certified lab, K/N Type housed in protective Inconel Tube, Duplex; Four number for three furnaces and in-situ temperature measurement

FLANGES		
1	Flanges (Water cooled)	1. SS flanges with double Viton O-ring for leak tightness. 2. Flanges with provision for vacuum and gas purging. Vacuum provision with KF 25 vacuum port. 3. Flange specially designed for easy sample loading and unloading with hinge type support 4. Flanges and tube to have heavy duty support 5. Flange to have provision for carrying thermocouple for in-situ temperature measurement of samples at two points simultaneously

MFC		
1	MFC	Flow Rate:0-1000 SCCM (for CH4 and Ar) Flow Rate:0-200 SCCM (for Hydrogen and Nitrogen) Four number MFC, One each for CH4, Hydrogen, Argon and Nitrogen
2	Power Supply	0-24 V DC
3	SS Double Stage Regulator	4 numbers
4	Gas Manifold with pipe line of SS310 for 10 meters from gas cylinder to furnace	1 number
5	SS Gas Piping	SS316
6	Necessary gas valves	Needle Valves

VACUUM SYSTEMs	
Turbo Molecular Pump (01)	$10E^{-6}$- $10E^{-8}$ torr
Mechanical Pump (01)	$10E^{-1}$-$10E^{-3}$ torr
Pirani gauge (01)	
Penning gauge (01)	

CHILLER SYSTEM		
1	Water Chilling Unit	A chiller unit to chill the water to circulate the SS fittings for the Quartz tube for better vacuum and air purging.
2	Capacity	20-30 liter tank
3	Temp controller	Automatic on/off Digital temperature controller with set temperature
4	Cooling	Automatic cooling on/off facility

5	Working Temp Range	5-10 ^{o}C
6	Water Circulation	10 lit/min
7	Wheel Mounting	The water chilling plant is constructed with the wheel to move the equipment easily
8	Switches	independent control for chilling plant and water circulation pump

CONTROL PANEL		
1	Temperature control system	Phase angle fired Thyristor, driven by touch-screen based PID temperature controller of minimum 16 segments
2	Software	To ensure ease of use a fully functional PLC/Graphical User Interface (GUI) built around National Instruments LabVIEW software. This PLC/GUI allows full control of each system parameter, allows the user to load and save custom growth recipes, and enables "1-click" unattended operation via an auto process feature. The Labview based system ensures standard recipes to run on system unattended. Pressure can be manually set between 0.1 to 30 torr during growth cycle
3	Temperature control resolution	+/- 1^{o}C for entire temperature range
4	Over current & temperature protection with alarms	Yes with system interlocks programmed in PLC

SPARES		
1	Sample placement rod	SS rod to place sample at center of hot zone
2	Labware	Quartz boat of length 10cm : 2 numbers
4	O-rings for flanges	1 set (4 numbers)
5	SSR for furnaces	1 set (2 numbers, 1 for each furnace)

EXTRA		
1	Training	Should train the at the students in the IITM institute premises immediately after completion of installation of equipment.
2	Manual	Should provide a detailed operating and service manual with drawing and circuit diagram in English.

Warranty: Min 1 year warranty

Installation : On-Site installation should be provided

Service : Service by Indian personal should be possible for all modules including the chiller.

General Terms & Conditions

- The vendor should have supplied a system of a similar or a higher specification to Indian institutes like IITs, etc. or, to a reputed foreign institute in the last 5 years. The vendor should provide the contact details of the user of such a system. The vendor should provide proof of installation and maintenance of such systems. Proof can be provided as reference letters from the users of the systems.