Sr No. 1 / Reference No. : 1

Detailed Description of Item:

Precision diamond scriber for different wafers

The tool configuration:

- Maximum scribe length (Y-translation): minimum 200 mm
- Maximum displacement transverse to the diamond scribe (X-translation): at least 100 mm with a resolution equal to or better than 20 ❍m.
- Wafers that may be scribed: Si, III-V, Ga2O3, Sapphire, glass and ceramic with diameters of up to 150 mm and thickness up to 5 mm.
- Minimum size of chip that may be scribed: 10 mm x 10 mm
- Must be provided with a microscope with an objective with 25X to 40X magnification, X-Y cross-hair and illumination.
- The angle of the scribe must be easily changeable.
- The vacuum chuck for holding the wafer (pieces) to be scribed must be able to hold the largest wafer and the smallest chip mentioned above.
- The scribing force must be adjustable between 0 and 500 gm
- The position of the scribe above the vacuum chuck must be easily adjustable
- Precise turning of the wafers/chips on the vacuum chuck by 90 ⌗ should be possible.
- Fine rotation of the wafers/chips must be easily controllable with a resolution equal to or better than 0.01⌗.
- After scribing, the scribe should disengage automatically. Additionally, provision for manual disengagement (lifting) of the scribe should be provided.
- Provision for manual disengagement of the vacuum pump should be provided.
- X-position indicator should be digital, with possibility of resetting the zero-position.
- The offer should include at least two spare diamond scribes.

Other requirements:

- A minimum warranty of 1 year
- Availability of technical support for preventative maintenance and troubleshooting is required.
- Strong record of providing the quoted tool in leading facilities across academia and industry will be considered (format 4).
- Video demonstration of the use of the tool will be required.

Sr No. 2/ Reference No. : 2

Detailed Description of Item:

Arbitrary Waveform Generator

1. Analog Bandwidth 1.25 GHz on all Channels or higher

2. No. of Channels 8 Channels in Single Box. All Channels should be Phase & Time Synchronous.
3. Output type Single ended or differential, 50 ⌖ DC coupled
4. DAC Resolution 16 Bits or higher
5. DC Coupled Amplitude 50 mVpp to 750 mVpp or larger (single-ended)
6. Sample Rate 2.5 GSa/s on all Channels or better. Operation with both internal and external clock.
7. Internal sampling clock frequency resolution - 7 digits or better
8. Output Phase noise (10 kHz offset) - 100 MHz carrier: < -130 dBc/Hz
9. Rise/Fall time (20 % to 80%) ⭘ 130 ps
10. Memory Points 2 GSa on each channel
11. Run modes Continuous, Triggered, Triggered Continuous & Sequence
12. Trigger delay to output Less than 50 ns
13. Waveform Granularity 32 points
14. Channel to Channel Skew ±25 ps or smaller
15. Skew setting range/resolution 5 ns /5 ps or better
16. Markers per Channel 4 Markers or more
17. Sequencing option 32000 sequence steps or better
18. Sequencer instructions Play waveform, play waveform segment, wait for trigger
19. Standard Waveform Sine, Square, Triangle, Ramp, Noise & DC
20. External Reference IN/OUT 10 MHz with SMA connector
21. External Trigger Input 2 Trigger Inputs
22. Control Software Appropriate control software for programming and operating the instrument via a PC. Support for Labview and Python APIs as well.
23. Interfaces & Operating System USB, LAN, Windows 10, GPIB
24. Mains Input Voltage 230V AC, 50Hz nominal
25. Warranty and Technical Support - 3 Years. Technical should be available within India.

Sr No. 3/ Reference No. : 3 (Revised)

Detailed Description of Item:

Fourier Transform Infrared Spectroscope (ATR-FTIR) FTIR Imaging system Technical

Technical Specifications :

Scope	FTIR Imaging system should be software controlled and fully automated.
FTIR General Parameters	
Spectral range	MID IR: 7500 – 450 cm^{-1} or better Far-IR: 700-50cm^{-1}or better
Source	Mid IR and Far IR source with 10 years warranty

Interferometer	Dynamically aligned Michaelson interferometer; insensitive to external vibrations and temperature effects with 10 years warranty
Beam splitter	Mid IR and Far IR range beam splitter with 10 years warranty
Laser	He-Ne laser sources (Mid and Far IR) with 10 years warranty
Optics	Suitable optics
External Beam	Should have facility for external beam
FTIR Imaging system	
Microscope Platform	FTIR imaging system should have Transmission, Reflectance, and ATR imaging modes
Aperture	Completely automated variable size aperture
Detector	Single element MCT and Linear Array detector. Additional detectors could also be quoted for microscopic applications for the samples of size down to 50 µm. All detectors must be permanently fixed and software selectable.
FTIR Microscope Calibration	NIST traceable polystyrene standards must be offered to check performance of the FTIR Microscope in all modes like transmission, reflection and ATR.
Micro-Attenuated Total Refection (ATR)	Imaging ATR with Germanium should be quoted. Micro ATR also should be offered.
Purge	Sample area purge should be available
Sample Viewing	
Sample Illumination	Software controlled LED's illumination must be available.
Video Image	High resolution color digital camera USB with 1024 × 768 low-noise CCD. Real-time 500 µm field of view. System should support additional monitor for best viewing comfort.
Real Time IR Spectrum	Simultaneous view of sample while collecting data. Full view of the sample area with aperture positioned, even during collection. Real time spectral preview and library search facility must be available.
FTIR Imaging Detector Specification	
Signal to Noise Ratio	Better than 500:1, @ 25 µm pixel size and 16 cm^{-1} Resolution, 4 scans for imaging
Ultra-fast Imaging	1.2 × 1.2 mm Area at 20 seconds / Stage Speed: 10 steps/sec / Interferometer Speed:

	150 spectra/sec or better

Stage	High precision motorized stage and joystick should be included
Objective	0.7 NA or better
Image Pixel Size	25/6.25 micron and 6.25 / 1.6 (or better) micron ATR imaging
Wavelength Range	7600 – 720 cm^{-1} or better
IR Imaging Collection Speeds	150 spectra per second or better
Software	➢ Principle Component Application, Multivariate Curve Resolution, Image processing using different profiles like peak area, peak height etc. ➢ Particle size analysis including counting number of particles along with IR spectra ➢ Software should capable for microscopic analysis of microparticles with different size and shape. ➢ The size and locations of identified regions should be used to position the specimen to align each region with an aperture and so to set the aperture to a size appropriate for collecting a spectrum from the region of interest. ➢ Software should have automated mixture analysis software for chemical identification of unknown sample especially multiple component sample by a completely automated way and report best possible spectral matches using spectral libraries. ➢ Software should have facility to perform analysis in automated way e.g., identification of particles of different size and adjusting the aperture accordingly before spectral acquisition.
Sample Preparation Kit	Kit containing carbide blade, roller and knife, needles, tweezers etc. must be offered. BaF_2/KBr windows – 4 nos. or more., Gold coated reflectance slides – 5 nos. or more. should be quoted.
Libraries	Licensed copy of ST Japan/ BIORAD/Aldrich / Hummel / only with minimum 10,000 General spectra & minimum 4,000 spectra for Polymer, Additives, Plasticizers libraries FTIR spectra should be supply along with instrument. **No pirated libraries** will be accepted. Library upgradation should also be provided for 5 years after installation free of cost.
Local Supply	All the pre requisition for installation like Branded PC of suitable configuration along with 2 nos. of 27” inch monitor, laser printer, required UPS etc. should be supplied along with system. Nitrogen cylinder with regulator and gas connection setup should also be supplied as needed.
Accessories	All accessories for the proper operation of instrument should be included as standard supply.

Terms and Conditions	• System performance should be demonstrated with necessary standards and calibration kits which will be provided by the vendor as part of standard delivery. **•All the system components supplied, should have warranty for three years from date of installations (except mentioned earlier) and 2 years AMC after that including all labour cost. Payment of spare parts if necessary will be made on as and when required basis.** • Warranty should include preventive maintenance kit, calibration kit. • No conditional warranty will be accepted. • Basic training for a period of one week after installation & commissioning of the equipment to technical personnel to be provided at our site. • On-site training of staff and students (at least twice in a year for 7 days each) during the first 3 years. • Good technical support should be provided after the installation of the instrument and the service engineer should be able to attend unlimited breakdown calls and should visit the installation site within 24 hours without fail. • Service support should be available for 6 days a week. • Training on troubleshooting the issues associated with instrumentation or application should be provided free of cost whenever required by the user. • Manufacturer should provide the service support details in Mumbai and India. Details of the service engineers and application specialists should be provided along with their experience on these kind of systems. • Details of the users (name, phone number and email ID) in India for the quoted instrument in the bid should be provided. • Instrument performance, quality of service and application support certificates from at least three existing users should be provided. • Thedeliveryperiodshouldbespecificallystated.Earlierdeliverymaybepreferred. **We may provide unknown samples to the vendors for analysis on the quoted models to verify their claims on technical specifications and reserve the rights to reject any or all quotations based on the results.**

- Submit technical brochure and a point by point compliance statement with your quotation.

Sr No. 4/ Reference No. : 4 (Revised)

Detailed Description of Item:

OPTICAL TENSIOMETER/ CONTACT ANGLE METER

Specifications of Optical tensiometer/Contact angle meter:

1)Optical Tensiometer/ Contact Angle meter: Capable for surface and interfacial tension, software controlled contact angle measurements, Surface Free Energy and dynamic contact angle 2)Light Source:LED-based background light with optimal contrast, 3)Measuring Range:0o to 180o 4)Measuring Resolution and accuracy: ± 0.3o or better 5)Zoom Lens11: 6.5X zoom lens with fine focus 6)Camera: Max camera frame rate 3000 fps or better Camera should be protected from liquids spills and mechanical damage with protection by the instrument covers 7)Image Processing System High-performance image processing system with at least 100 MBPS or better data transfer rate 8)Dispensing type: i) Automatic High Precision Single Liquid Dispenser with both manual and Software Controlled dispensing. ii)Glass syringe and other should require accessories supply as standard Disposable tip dispensing option without any syringes for removing the need of dispenser cleaning, selection of different disposable tips if required. iii)Needle adopter pack as standard supply if required iv)Other required adopters and disposable needles if required v)All accessories for the proper operation of the instrument should be included as standard supply. 9)Sample Stage XYZ movement.Sample stage with manual precision x (80 mm)-y (80 mm)-z (10 mm) movement and a fast vertical adjustment. Automatic may be quoted separately 10)Sample Size: 50 mm x 50mm 11)Tilting stage/range May be quoted separately assembly with Resolution of 0.1 for measurement of dynamic contact angle with range of 0o to 90o∈ 12)Surface Tension Measurement Range:0.01 to 2000 mN/m1 13)Surface Tension Measurement resolution:0.01 mN/m or better resolution 14)Image Fitting Polynomial, Basforth-Adams or similar, circular fit, Young-Laplace, including auto baseline algorithm 15)Surface free energy, based on calculation equations: Zisman, OWRK/ extended Fowkes,Wu;Acid- Base Equation of State; Schultz 1; Schultz 2 16)Software Determination a) Contact angle by sessile/rising drop method with automatic base line detection b) Surface/ interfacial tension by pendant/ rising drop method c) Contact angle by liquid meniscus method or similar d) System should have Software for controlled drop size pulsing for interfacial rheology measurement of viscoelastic properties of interfacial layers at liquid-air or liquid-liquid interfaces e) Software for roughness corrected contact angle/ 3D topography/ top view system or similar f) Software for dynamic contact angle measurement, the advancing, receding contact angle and contact angle hysteresis are detected a utomatically. g) Software for batch contact angle mode with instant result grid, including multiple samples, measurements points and time points or similar Volume from image functionality in the software with adjustable tolerance limits that controls the droplet volume 17)Upgradability of the instrument: The software and the instrument should have adequate provision for up gradation to incorporate additional features as and when required. Must have provision to upgrade for integrated 3D Topography system/ roughness corrected contact angle/top view system for advanced adhesion and wettability studies for surfaces. Must have the option of upgrade for using High Pressure Chamber option with possibility to increase pressure Must have provision for upgrade to external tilting cradle for accurate measurement of advancing and receding angles on

hydrophobic substrates. 18)Local Supply:All the pre requisition for installation like Branded PC (3 yrs warranty) of suitable configuration along with 1 nos. of Branded monitor (3 yrs warranty), key-board, and mouse required UPS etc. should be supplied along with system.

Terms and Conditions

1. System performance should be demonstrated with necessary standards and calibration kits which will be provided by the vendor as part of standard delivery. 2. All the system components supplied, should have warranty for two years from date of installations (except mentioned earlier) and 3 years AMC after that including all labour cost. Payment of spare parts if necessary will be made on as and when required basis. 3. Warranty should include preventive maintenance kit, calibration kit. No conditional warranty will be accepted. 4. Basic training for a period of 2 days after installation and commissioning of the equipment to technical personnel to be provided at our site. 5. On-site training of staff and students (at least twice in a year for 2 days each) during the first 3 years. 6. Good technical support should be provided after the installation of the instrument and the service engineer should be able to attend unlimited breakdown calls and should visit the installation site within 24 hours without fail. 7. Service support should be available for 6 days a week. 8. Training on troubleshooting the issues associated with instrumentation or application should be provided free of cost whenever requiredby the user. 9. Manufacturer should provide the service support details in Mumbai and India. Details of the service engineers and application specialists should be provided along with their experience on these kind of systems. 10. Details of the users (name, phone number and email ID) in India for the quoted instrument in the bid should be provided. 11. Instrument performance, quality of service and application support certificates from at least three existing users should be provided. 12. Evaluation will be done on the basis of technical specifications as per our tender notice. 13. Financial bids will be open only for those, who meets all technical specification. 14. Maximum educational discounts should be applied. 15. The delivery period should be specifically stated. Earlier delivery may be preferred.

We may provide unknown samples to the vendors for analysis on the quoted models to verify their claims on technical specifications, and may ask for technical presentation also and reserve the rights to reject any or all quotations based on the results.

Acessories:

1)Temperature control chamber electrically heated, ambient to 250°C 2)Roughness corrected contact angle/ 3D topography:yes 3)Automatic dispenser:yes 4)External Tilting Cradle:yes All accessories for the proper operation of the instrument should be included as standard supply.

Sr No. 5 / Reference No. : 5 (Revised)

Detailed Description of Item :

POTENTIOSTAT/ ELECTROCHEMICAL SYSTEM with EQCM.

Technical Specification - :

A) Electrochemical system/Potentiostat: A electrochemical workstation (upgradable to multichannel) with EIS and e-QCM capability. Please quote the price for 2, 4 and 6 additional channels. USB Chassis may be quoted if required. 1.Compliance Voltage - ±20V 2.Current Range (Full Scale) - ±400 mA to 10 nA or better 3.Output Voltage Range - ±10V or better 4.Measured current resolution - 0.0003% at entire current range Must be a default hardware configuration without any additional amplification 5.measured Potential Resolution - 3µV or better 6.Potentiostat Rise/fall Time - 1 µs or lower 7.Interface - USB interface for connection with PC. 8.Multichannel - Upgradeable to multichannel 9.Input impedance of electrometer- 10^11 Ω or better 10.Maximum scan rate - 200 V/s at 2 mV step height or better 11.Input bias current of electrometer - 20 pA or better 12.Boosters - Compatible with boosters 13.Additional accessory - All accessories (RE, WE electrodes, cells, and filling solutions) for the proper operation of instrument should be included as standard supply.

B) Independent EIS Configuration:

1.Applied Frequency Resolution - 0.005% At 1 Hz frequency, impedance of 0.01 Ω must be determined with 0.3˚ Phase accuracy & at least 0.3 % measured impedance accuracy. i.e – Measured impedance = 0.01 ±0.00003 Ω. 2.Frequency Range with Potentiostat/ Galvanostat - 1 MHz to 10 µHz or better at given current (±400 mA or better) 3.A built-in EIS Simulation - Required 4.live lissejous plots - Required 5.live 3D plotting - Required but not compulsory 6.real-time view of 10+ plots - Required but not compulsory 7.Supplier should provide an officially published contour plot of FRA when connected with similar Potentiostat/ Galvanostat from the same supplier. – Required

C) EQCM:

The instrument must be equipped with an EQCM module to perform Electrochemical Quartz Crystal Microbalance experiments with measurements in the sub µg/cm2 or better should be possible.

Should include as standard supply - Suitable Software - Temperature-controllable QCM Cell - EQCM Flow Cell Reference Electrode (Ag / Agcl) - Au-Coated Quartz Crystal (5MHz)- 10 Nos - Flow cell with peristaltic Pump for eQCM flow cell - All required accessories to connect with the electrochemical analyzer should be quoted as standard supply.

Additional accessories :

Different additional cells like other flow cells, immersion probes, and other required electrodes with the EQCM should quoted separately

- All required accessories to connect with the electrochemical analyzer should be quoted as standard supply

- 5 MHz C-coated Quartz Crystal, Wrap-around electrodes, qty 5 (may be quoted separately) - 5 MHz Fe-coated Quartz Crystal, Wrap-around electrodes, qty 5 (may be quoted separately)

3. Oscillation frequency - In between 1-10 MHz or better

4. Resolution - 0.07 Hz or better

5. Frequency range - 80000 Hz or better

Electrodes and EC cells :

A 3-electrode Set-up: Basic EC Cell Set up: Qt. 2 WE – 2 or 3 mm GC; CE – Pt Spiral or straight; RE - Ag/AgCl; Vessel - 50 mL PEEK; Gas-in/Gas-out option, Polishing Kit for polishing Electrodes. A Faraday Cage should be quoted as well. All these included as standard supply.

D) Software:

The system software must have capability for hybrid measurements such as Spectroelectrochemistry, E-SPR, IMPS-IMVS, EQCM, etc. It should have TTL triggering, ADC, DAC based communication ports. The Software must be able to be downloaded to unlimited computers & fully windows based. Software should be capable of supporting a wide variety of electrochemical techniques for advanced sensor research (50+ modern electroanalytical techniques).

- Real time Plotting: Powerful graphic engine with useful features

- Corrosion: Linear polarization with Tafel Slope Analysis, Polarization resistance evaluation, Electrochemical Noise analysis, critical pitting technique, electrochemical frequency modulation, hydrogen permeation analysis, etc.

- Battery &Supercapacitors Analysis: Rectangular CV analysis at varying scan rates for pseudocapacitor analysis, complete charge and discharge with built in integration and 'linkable' cutoffs, Galvanostatic charge discharge with cycle number vs specific capacitance plot, Voltage measurement on counter electrode, etc.

- Electro-catalysis: ORR analysis using RDE/RRDE at varying rotation speeds and built-in Koteckylevich plot generation, HER and OER analysis for water splitting, Carbon dioxide reduction analysis, default technique for spectro-electrochemistry based LSV, CV and Chrono evaluation.

- Sensors: Advance Sensor Research/ Development and Conducting polymers applications

EQCM: Suitable software to run the EQCM related analysis.

E). Accessories : All accessories for the proper operation of instrument should be included as standard supply. Other important accessories can be quoted separately.

F) Local Supply : All the pre requisition for installation like Branded PC (3 yrs warranty) of suitable configuration along with 1 nos. of 27” inch Br anded monitor (3 yrs warranty), required UPS etc. should be supplied along with system.

Sr No. 6 / Reference No. : 6 (Revised)

Detailed Description of Item: Thermal analysis of materials TGA and DSC

Specification sheet for Differential scanning Calorimeter	
Instrument Design	Heat flux or Power Compensation
Furnace Temperature Range	-85 to 700°C
Temperature Accuracy	±0.2°C or better
Temperature Precision	±0.02°C or better
Temperature Repeatability	±0.05°C or better
Heating Rate	0.01 to 200°C/Min
Cooling Rate	0.02 to 50°C/Min
DSC Measurement Range	±175 mW or More
Heat Flow Resolution	0.02 µW or better
Heat Flow Sensitivity	0.02 µW or better
Enthalpy Precision	±0.06% or better
Enthalpy Repeatability	±0.3%
Baseline Linearity (-50°-300°C)	<10 µW
Baseline Repeatability (-50°-300°C)	<20 µW
Baseline Accuracy (-50°-300°C)	±30 µW
Gas Atmosphere	Atmosphere can be static or dynamic, including nitrogen, argon, helium, carbon dioxide, air, oxygen or other inert or active gases over full temperature range
Indium Peak	(height to width) ratio 15 or above
Modulated DSC	Modulated DSC must be capable to: • apply sinusoidal temperature wave to sample. • separate reversing het flow and non reversing heat flow • The temperature modulation should be strictly periodic to ensure continuous steady-state control and exact experiment reproducibility, random temperature perturbations are not acceptable. • perform quasi-isothermal experiments, i.e. holding isothermal with a small temperature modulation
Upgradability	The instrument should have the capability to be upgraded with future requirements
Calibration Kit	System should be provided with calibration kit for temperature and enthalpy
Sample Sealing	Universal Sample sealing press should be provided to crimp all types of pans like solids and liquids
Software	Shall have provision to evaluate Glass transition temperature, Decomposition exotherm, Melting, Hazard assessment/sensitivity, Phase transition, CP value (Heat Capacity), Purity, Crystallization, Onset value, Enthalpy value, Modulated DSC
Accessories	Aluminum pans should be provided along with the crimping tool

Warranty	Instrument warranty should be covered for 1 year and additionally 2 years of AMC

Specification sheet for Thermogravimetric analyser	
Sample Weight Capacity	1 g or better
Dynamic Weighing Range	1000 mg or better
Weighing Precision	± 0.01%
Sensitivity	0.1 µg
Balance Design	Vertical Hangdown wire or horizontal
Temperature Range	ambient to 1000 °C or better
Temperature Accuracy	±1°C
Dynamic Temperature Precision	±1°C
Isothermal Temperature Precision	±0.2°C
Linear Heating Rates	0.1 to 100°C/min or better
Furnace Cooling	1000°C to 50°C in < 25 min or better
Dynamic Baseline Drift (50 to 1,000 °C)	<25 µg, with platinum pans
Signal Resolution	0.002µg
Gas Atmosphere	Atmosphere can be static or dynamic, including nitrogen, argon, helium, carbon dioxide, air, oxygen or other inert or active gases over full temperature range
Gas Flow Rate	Up to 200 mL/min or better
Upgradability	The instrument should have the capability to be up-graded with future requirements
Software	Should be able to analyse Weight change, Residue con-tent, Weight loss at a specified time or temperature, Peak height and area, Onset and endset analyses, Step transi-tion analysis
Accessories	100µl platinum pans minimum 3, Suitable PC, Ups should be supplied of 5 KVA with 1 hr back up to take the load of both the instruments
Warranty	Instrument warranty should be covered for 1 year and additionally 2 years of AMC

Sr No. 7 / Reference No.7.

Detailed Description of Item:

N2 plasma cells and its accessories (such as Power supply and Auto Tuner) for growing GaN based materials. It's a component of bigger equipment (Molecular Beam Epitaxy). This equipment is housed in the IIT Bombay's nanofabrication facility, (IITBNF) and was imported and installed 6 years ago. This is for GaN growth of electronic and optoelectronic materials.

RF Plasma Source for Nitrogen should perform precise and controllable growths resulting in high quality end devices.

Plamsa Bulb

- Plasma source should be of brazed bulb design. Brazing the bulb to the plasma source leads to the best seal; drastically lowering the possibility of leakage and greatly improving the plasma control.

- Plasma chamber should be constructed of all PBN (Pyrolitic Boron Nitride) to lower the risk of oxidation inside the bulb.

- Plasma chamber should be constructed with a single piece PBN gas inlet tube and plasma bulb to eliminate gas leakage around the bulb.

Nozzle

- Nozzle should be designed Using Monte Carlo Software. The software takes many variables into account, like source to substrate distance, gas flow, system geometry, etc. This software gives the ability to custom design a plasma source nozzle perfectly tuned to the end users system. This is to give the best uniformity and end devise quality.

- Plasma source should provide field Replaceable Nozzle facility. This is a beneficial feature to change flux profile with another customized nozzle.

- The exit whole design should be such that it minimizes ion content in the beam, while the active neutral species (atomic and molecular) are directed toward the substrate.

- Nozzles should be available for most commercial MBE systems and ensure typical uniformity of ±1%.

Water Cooled RF Feed through

RF Plasma source should have water cooled RF Feedthrough.The water cooled RF Feed through on the Nitrogen Plasma Source effectively takes heat away from sensitive in-vacuum to out-vacuum transition areas. This leads to better flux control as well as extending the life-time of the source.

Demonstrated Performance

• Supplier should have record of having supplied more than 250 RF sources globally.

• Demonstrated growth of AlGaN/GaN high electron mobility transistor (HEMT) with 2DEG mobility as high as >/= 16,000 cm2/Vsec at 77K, >/= 50,000 cm2/Vsec at a temperature higher than 10K and room temperature (300K) mobility of >/= 1800 cm2/V.sec with 2DEG density as high as 5.0*10^12 cm-2

• Demonstrated production of AlGaN/GaNPI-HEMTs which show small signal RF performance and DC breakdowns as a function of gate length that are as good as the best transistors made by MOVPE

• Must have demonstrated GaN growth rates as high as >/= 2.5µm/hr.

• The plasma source must possess metastable molecules during operation to exhibit a high incorporation rate in GaN growth and stabilize the growth rate at high substrate temperatures

• Must have record of demonstrating record low threshold currents for 1.32µm GaInNAs/ GaAs quantum well lasers

• Demonstrated production of 1.26µm In GaAsNVCSELs compatible with telecom network requirements

Scope of Supply should include: RF Source for Nitrogen and required accessories.

*** POWERSUPPLY**

CONTROLLER, DC POWER MODULE Configured as follows:

DC Power Module

RF - Plasma Source RF Generator

RF - Plasma Source RF Generator

RF Power Connector Option

220EU - Continental European 220VAC

*** AUTOTUNER**

RF AUTOMATIC MATCHING UNIT Configured as follows:

AUTOTUNER SOURCE

N2 - NITROGEN PLASMA SOURCE

Sr No. 8/ Reference No.8.

Detailed Description of Item:

Specifications for a cryogen-free dilution refrigerator with pulse-tube cryocooler, superconducting magnet, and coax wiring

Purpose: A dry cryogenic system, equipped with a pulse-tube cryocooler and compressor, and consisting of a superconducting magnet, is required for low temperature (between 10 mK and 1 K) transport measurements, with focus on quantum computing with electron spins in silicon. The system will be installed in the Physics department of Indian Institute of Technology, Bombay.

Detailed specifications:

1. **The cryostat: (a) The vacuum enclosure and the radiation shields should be light weight and split in two parts, such that to gain access to the dilution unit, only the lower part need to be removed.**

(b) A turbomolecular pump separate from the one used for the ^{3}He circulation should be provided for vacuum pumping

2. **The dilution refrigerator insert: (a) The insert should have all the necessary KF ports on the top flange, for (i) the pulse tube, (ii) the condensing line, (iii) the pumping line for the cryostat vacuum, (iv) the still pumping line, (v) the current leads for the superconducting magnet, and (vi) magnet diagnostic line. Additional KF ports allowing the necessary wiring (described later) should also be available on the top flange.**

(b) The dilution unit should be removable/replaceable without disturbing the experimental plates/wiring

(c) The pulse tube unit should be replaceable without disturbing the dilution unit/experimental plates

(d) The space beneath the mixing chamber should be wider than the bore of the superconducting magnet and sufficiently long to accommodate the same.

(e) Heat-exchanger unit should be free of soft-solders to avoid any possibility of leaks.

3. **Base temperature/Cooling power: The base temperature should be 10 mK or lower. The cooling power should be (a) ≥ 12 at 20 mK (b) > 400 at 100 mK, and (c) > 600 at 120 mK, and (d) 2 W at 4.2 K with complete wiring and outside the mixing chamber.**

4. **Gas Handling system**

(a) The gas handling system (GHS) should provide the possibility of (i) computer-controlled fully automatic, as well as, (ii) completely manual control of the cool-down sequence, to reach the base temperature.

(b) The gas handling system should be *completely oil-free*, using suitable pumps for ^{3}He circulation and other requirements.

(c) The GHS should be provided with both internal and external liquid nitrogen cold trap.

(d) Control valves, flowmeters, safety and pressure regulators, gauges and electronic units of the GHS should be of very high quality (sourced from well-established manufacturers with proven track-record of reliability)

(e) Provision for robust electrical and mechanical isolation of the GHS from the cryostat using suitable clamps, spacers, and dampers should be provided.

(f) The turbomolecular pump for ^{3}He circulation should be separated from the one for vacuum pumping of the cryostat.

5. **<u>Diagnostic/Control Electronics:</u> (a) The necessary electronic unit for control and monitoring of the resistance thermometers and heaters should be provided, along with the appropriate software to run the unit from a PC and through web interface.**

6. **<u>Safe recovery in the event of power failure:</u> The control unit should have the provision for putting the unit in a safe mode (including avoidance of quench of the superconducting magnet system).**

7. **<u>Magnetic field:</u> (a) The superconducting magnet should be capable of producing a field of minimum 9 Tesla, with a homogeneity better than (or equal to) ±*0.1% DSV*.**

(b) The magnet should be easily removable from the bottom of the dilution unit.

(c) The field stability must be better than 0.05% drift per hour.

(d) The bore diameter should be equal to or larger than 4 inch, such that the sample space is minimum 90 mm.

(e) The magnet should have a persistent mode switch offering field stability better than 50 ppm drift per hour at full field.

(f) The magnet should have suitable quench protection mechanism.

(g) The magnet should be provided with the necessary power supply, magnet temperature sensor and readout, and current leads. The power supply should be capable of "four-quadrant" operation and smooth zero crossing. No mechanical switching or glitch should occur when the magnetic field is ramped through zero value.

(h) Ramp rate up to approximately 1Tesla/minute is required.

(i) All the functions of the magnet supply should be accessible through an IEEE-488 (GPIB) interface.

(j) Necessary accessories enabling use of the system without the magnet should be provided.

8. **<u>Wiring</u>: Following experimental wiring should be provided.**

***DC lines*: (a) 12 twisted pairs of Cu (AWG 35) wiring from 24-pin Fischer connector at room temperature to 4K, followed by 12 twisted pairs of CuNi wiring from 4K to the mixing chamber plate, with micro-D break at 4 K.**

(b) 12 twisted pairs of Cu (AWG 35) wiring from 24-pin Fischer connector at room temperature to 4K, followed by 12 twisted pairs of NbTi wiring from 4K to the mixing chamber plate, with micro-D break at 4 K.

(c) 12 twisted pairs of CuNi wiring from 24-pin Fischer connector at room temperature to mixing chamber plate, with micro-D break at 4 K.

(d) 12 twisted pairs of Cu wiring from 24-pin Fischer connector at room temperature to 4K, terminated by nano-D connector, with magnetic shielding.

***RF lines:* (a) Vacuum flanges with necessary feedthroughs and additional thermal anchoring flanges at 50 K and 4 K for the experimental wiring mentioned below should be provided.**

(b) 1x 2.19 mm CuNi-SCuNi semi-rigid coax cable between RT and 4 K followed by 2.19 mm CuNi-SCuNi coax cable between 4 K and mixing chamber plate. All connectors should be of K 2.92 mm (40 GHz) type

(c) 1x 2.19 mm CuNi-SCuNi semi-rigid coax cable between RT and 4 K followed by 2.19 mm NbTi-NbTi coax cable between 4 K and mixing chamber plate. All connectors should be of K 2.92 mm (40 GHz) type

(d) 1x 2.19 mm CuNi-SCuNi semi-rigid coax cable between RT and 4 K followed by 2.19 mm CuNi-SCuNi coax cable between 4 K and mixing chamber plate. All connectors should be of SMA (18 GHz) type.

(e) 1x 2.19 mm CuNi-SCuNi semi-rigid coax cable between RT and 4 K followed by 2.19 mm NbTi-NbTi coax cable between 4 K and mixing chamber plate. All connectors should be of SMA (18 GHz) type.

(f) 8 x CuNi-SCuNi semi-rigid coax cables, with graphite-coated FEP dielectric designed for 50 Ohm characteristic impedance, and provided with SMA (18 GHz) connectors, between RT and mixing chamber plate, with breakout at 4 K plate.

(g) 0dB attenuators at 50K, 4K, still, cold plate, and mixing chamber should be included.

9. **<u>Vibration isolation:</u>**

(a) The cryostat support frame must provide separation of the cryostat top and pulse tube ballast tanks and motor to minimize the vibration transfer to the cryostat from the pulse tube, e.g., a separate shelf for placing the pulse tube components.

(b) The cryostat must be isolated from the support frame and pulse tube components (ballast tanks and motors) via active (for example: using controlled spring action) vibration damping system (in the 1-200Hz range).

10. Essential accessories:

(a) Two fully shielded breakout boxes specialized for low-temperature experiments. The breakout should extend the Faraday cage of the cryostat, going from a 24-pin Fischer connector to a 24- channel BNC connector panel. All wiring inside the break-out box should be done in twisted pairs for best noise immunity. Switches to enable connection of each channel directly to ground or a common bus should be provided.

(b) A He leak detector system, capable of operating in vacuum and sniffing leak detection modes, with minimum He leak detection rates of 5 $x10^{-12}$ mbar l/s and $5x10^{-9}$ mbar l/s, respectively, and supported by oil free pumping system, must be included in the quote.

(c) Tool kits for replacing, refurbishing experimental wiring.

(d) Tool kits for mounting/removing vacuum flanges and vacuum enclosures must be included.

(e) 2x gold-plated Be-Cu cold finger, as per the design provided by us should be included.

11. Warranties and contracts

(a) Comprehensive warranty for the entire system and essential accessories for minimum 36 months

12. Track record, presentations, and references

(a) Feedback of end-users (as obtained by us), specifically for semiconductor spin quantum computing research, will be critically considered.

(b) Proven track record of installation and service to customers based in India and/or elsewhere should be provided.

(c) The technical bid must contain point-by-point technical compliance data. If required, the bidder will make available for meetings for technical clarifications.

13. Installation, commissioning, and training should be provided by the vendor at our site. The cost towards this should be included in the quotation.

Sr No. 9 / Reference No.9

Detailed Description of Item: Aerobic/Anaerobic Respirometer System :

Specifications:

S.no.	Specification	Remarks

1.	**Mode of operation: Aerobic and anaerobic**	**Should also contain CO_2 in-line stripper.**
2.	**No. of reactors: 8 (modular)** **Capacity of reactor: 250 ml-1000 ml**	**With stirring base mechanism for adequate mixing** **Water bath for temperature control and heating recirculation (30-70 ºC): 8-position water bath and cover**
3	**Gas Flow Measurement**	**0.03mg of oxygen per input cycle to 1000 mg/hr** **Anaerobic gas flow: 5 -2000 mL/hr**
4.	**Parameters to be measured: methane generation, carbon dioxide generation, oxygen uptake rate, respiration activity.**	**-sensitivity for aerobic environment-0.05 mg** **-sensitivity for anaerobic environment- 0.05 ml** **Should have oxygen pressure control module**
5.	**Laptop with data collection/ acquisition module**	**Data recording interval should be at least between 1 minute to 60-minute range with flexible adjustment of recording interval during experimental run.**
6.	**Materials**	**The control modules and stirring units should be of stainless steel.** **Covers should be made of high-density polymer for durability and corrosion resistance.**
7.	**Stirrer Mixing Speeds**	**The mixing speed for each reactor should be independently controllable with range of 100 to 1000 rpm.**
8.	**Installation and onsite user training must be included.** **The instrument should be ready in all aspects and ready to use.** **Also, may include the necessary consumable like glass ware.**	

9.	**Bidder should provide a minimum 2-year warranty on the complete instrument.** **Bidder should quote for 1- and 2-year AMC as a separate line item.**	
10.	**All standard accessories like battery charger sampling pipe and others must be included for measurement of required gases in the portable analyser.** **Calibration certificate for the sensors and operating manual for the device must be provided. (Reference material should be provided to ensure accuracy of instrument).**	

Note:

1. **As reference, details of systems (Format 4) previously installed in reputed Govt. Institutions/Research Laboratories in last 3-5 years must be provided. Past PO copies can be provided along with the Technical Bid. The feedback from previous organization will be considered for technical evaluation.**

2. **The data recorded and processed by the software program should generate excel spread sheet containing information as: date, time, flow (ml/hr) or (mg/hr), gas concentration and valve number**

3. **The software which will be installed in the PC should also be provided in CD/DVD/ USB.**

4. **The instrument must have electrical compatibility with the Indian power outlet in terms of voltage, phase and current.**

5. **The technical committee may ask the vendors to demonstrate the working of respirometer, if the committee is not specified with the provided information.**

Sr No. 10/ Reference No. 10

Detailed Description of Item:

1. Hardware for research-grade wireless and wearable fNIRS combined with an EEG system:

A. Research-grade wireless and wearable fNIRS system:

Following features/configurations/requirements should be delivered (along with all the hardware, software and accessories). Notably, at least five studies should have been published in reputed international journals by using the quoted fNIRS combined with an EEG system.

• Must have a minimum of 8 fNIRS channels.

• Must be able to use all fNIRS channels to collect data from any part of the whole head (full cortical surface) including frontal lobe.

• Must have high power and low power with dual-wavelength NIRS source.

• The minimum sampling rate should be at least 6Hz.

• Must be able to acquire hemodynamic changes (oxy-, deoxy-, total haemoglobin levels) at the surface of the brain and at least up to 1-2 cm below the cortical surface.

• fNIRS combined with an EEG system must possess multi-modal compatibility to be used along with the ExG/GSR/SpO2/other biosignal devices and allow simultaneous recording of multi-modal data.

•Must work in sync with GTEC's "g.HIamp 64Ch Research" EEG system (MATLAB SIMULINK/python API based).

•The fNIRS system must stream data in real-time to another data processing hardware/software through TCP/IP/UDP or using other network protocols.

•Technical assistance for integration of the fNIRS channels with the EEG system must be provided after the sale of the fNIRS combined with an EEG system.

•The fNIRS system must be powered by lithium-Ion battery packs, which can allow continuous fNIRS recording for at least 3 hours.

•All fNIRS system modules meant for fNIRS, and auxiliary channels must be modular and wearable.

• NIRS caps must support concurrent use with electroencephalography electrode (EEG) devices proposed for clauses.

B. <u>Research grade wireless and wearable EEG system:</u>

Following features/configurations/requirements should be delivered (along with all the hardware, software and accessories):

• EEG amplifier must be a minimum 32-channel amplifier system with active electrodes and continuous-simultaneous recording capability on all channels

• All EEG amplifier modules meant for EEG, and auxiliary channels must be modular and wearable.

• Should have up to 32 mono-polar / 16 bi-polar input channels with GND and REF (software selectable).

• The amplifier must have simultaneous attachment provisions (via analogue input, digital input, attachment on EEG Channel, etc.) for all of the listed Wearable and wireless sensors (in this point) - galvanic skin response GSR - electrocardiogram ECG - Temperature and respiratory sensor or EMG

• EEG amplifier must enable acquisition with lesser number of EEG channels (e.g., 1 to 32 channels)

• Each of the amplifier channels must have a sampling rate of at least 240Hz at 16bit resolution.

• The amplifier should have 3-axis accelerometer.

• Amplifiers must be powered by lithium-Ion battery packs which can allow continuous EEG recording for at least 3 hours.

• It should be a real DC-coupled amplifier.

• It must be possible to house the acquisition computer and the setup (wearable: EEG cap, amplifiers, etc.) in different rooms. Appropriate extension cables and connectors must be provided to run cables during installation.

• Should have 8 digital trigger inputs at the amplifier base station.

• Must work in sync with GTEC's "g.HIamp 64Ch Research" EEG system (MATLAB SIMULINK/python API based).

• Supplied 32 Active gel-based electrodes must possess active preamplifiers and preferable with impedance measurements on the electrodes themselves or on the amplifier.

• fNIRS combined with an EEG system electrode cap must support continuous recording with stable impedance over a time period of at least 3 hours.

• EEG caps should support easy cleaning and maintenance.

• EEG caps must support concurrent use with near-infrared spectroscopy sources/detectors (fNIRS) devices proposed for clauses.

• It should have a USB interface for data transfer to the PC/Laptop.

2. <u>Software for research-grade wireless and wearable fNIRS combined with an EEG system</u>:

• The software should provide integrated and independent functionality where fNIRS and EEG system can be used independently or simultaneously together in synchronized data acquisition.

• fNIRS combined with an EEG system software must acquire fNIRS and EEG data simultaneously and synchronized, along with other biosignal data (ExG, GSR, SpO2, pulse, respiration, airflow, etc.) synchronized.

• This software must be compatible (synchronization) with GTEC's "g.HIamp 64Ch Research" version. It is a responsibility of a vendor to set up this system and licenses to the required specification.

• fNIRS combined with an EEG acquisition system must provide for real-time visualization of all channels connected to the system, including external triggers from stimulation devices (audio, visual, peripheral nerve, bio-signal sensors, etc.).

• fNIRS combined with an EEG acquisition system must contain a provision to change acquisition settings on each channel and also adjust montages of the recording setup.

• fNIRS combined with an EEG acquisition system must allow easy change of reference electrode of EEG for data acquisition.

• The acquisition and review software should provide a synchronized and integrated solution to capture fNIRS, EEG, ECG, EMG, GSR, SpO2, pulse, respiration, airflow, etc.

• The recorded data format must be easily readable and analyzable with major EEG processing toolboxes (such as Fieldtrip, MNE-Python, BrainStorm, SPM, etc.) and with major fNIRS processing toolboxes (such as HOMER2, etc.).

• The amplifier should be supplied with a real-time processing software interface (SIMULINK/Python API based) with real-time access to bio-signal data acquired by the amplifier.

3. Consumables for research-grade wireless and wearable fNIRS combined with an EEG system:

• fNIRS combined with an EEG system caps: Kids (6 years or 6+ years old) and adult (8-32 inch) caps should be supplied in Small (2 quantity), Medium (2 quantity), and Large size (1 quantity).

• Extra battery pack for fNIRS combined with an EEG system should be supplied.

• Wearable and wireless sensors (hardware, software, and accessories for all listed sensors should be supplied) for the synchronized recording of data - galvanic skin response GSR - electrocardiogram ECG - Temperature and respiratory sensor and EMG

• Spare electrodes for EEG (at least 4 quantities)

• Cable to connect amplifier to the computer (trigger cable)

• At least 500 grams of abrasive gel should be supplied (for skin preparation while using the active/passive electrodes for recoding).

• At least 1 litre of water-soluble, non-abrasive, high viscosity gel should be supplied (for skin preparation while using the active/passive electrodes for recoding).

• Two quantities of syringe should be supplied (will be used to fill the gel into the active/passive electrode).

Sr No. 11/ Reference No.12

Detailed Description of Item: 2inch T2SL EPI wafer-MWIR, 2inch T2SL EPI wafer-LWIR

T2SL EPI Wafer MWIR – 5 No

Layer	Composition	Thickness (nm)

1	**n+ SLS**	**100**
2	**uid SLS**	**200**
3	**uid AlAsSb**	**150**
4	**uid SLs**	**2500**
5	**n+ SLs**	**500**
6	**uid GaSb**	**200**
Substrate	**n-GaSb <100>**	

T2SL EPI wafer LWIR – 5 No

Layer	Composition	Thickness (nm)
1	n+ InAs	10
2	n-SLs, InAs/AlSb	360
3	p InAs/GaSb SLs graded to n InAs/AlSb SLs	400
4	p absorbing SLs, InAs/GaSb	3000
5	p SLs, InAs/GaSb	120
6	p+ SLs InAs/GaSb	200
7	P+ GaSb buffer	400
Substrate	n-GaSb <100>	

Sr No. 12/ Reference No.13

Detailed Description of Item:

Ultrafast Ti:Sapphire Amplifier :

Note 1: All components are necessary unless "OPTIONAL" clearly specified against them. Some suggestions for the suitable option are provided based on previous experience.

Note 2: In the technical bid, point by point list should be furnished to demonstrate requirements have been met.

Other important terms :

1. **The system should come with a warranty of one year. During warranty, at least 3 maintenance/breakdown services should be provided.**

2. **Door to door duty delivery paid for all components. IIT Bombay would provide the exemption certificates as applicable. This will be used for L1.**

3. **The authorization letter should be furnished along with the quotation.**

4. **The compliance statement should be enclosed with the quotation.**

5. **Indian agent should furnish a letter of authorization from the manufacturer along with the quotation. Also, the manufacturer should have ISO9001or similar certifications.**

6. **Indian agent should have trained service personnel to provide efficient after-sales service support. Names of those personnel along with their training certificates, should be furnished along with the quotation.**

7. **At least five similar systems must have been installed by Indian agent or the parent company.**

8. **The installation should be done free of cost for all equipment. Training to operate the instrument must be given to our research scholars at free of charge.**

9. **Trained Service engineers in India or directly from OEM should be available to resolve technical problems within a week.**

10. **The vendor should take total responsibility for installing the amplifier with spectrometer and demonstrating the performance.**

11. **All power supplies should be of Indian type 230+/-10% Volts, 50 Hz, with Indian standard plugs.**

12. **In technical bid, technical specifications described below should be substantiated with data measurement of stability, beam profile, beam pointing stability etc. The inability to do so will lead to disqualification from the tender process.**

The three amplifier components and their specifications are as mentioned below:

(a) SEED LASER :

I. **Seed laser should be automated mode locked single box Titanium Sapphire Laser Oscillator with integrated CW pump laser. Part of the oscillator beam should be used to seed the amplifier and at least150mW should be available simultaneously to be used for any independent experiments.**

II. **Central wavelength : ~800 nm**

III. **Power :> or equal to 450 mW at the highest bandwidth**

IV. **Bandwidth :> or equal60 nm (fixed or tunable)**

V. **Pulse duration : 20 to 35 fs**

VI. **System should have the capability of generating <20 fs pulses using external compressor. Quotation of external compressor is optional.**

VII. **Pulse repetition rate : ~80 MHz**

VIII. **Power stability :<+/-0.5% over 2 hours**

IX. **RMS Noise (%) : <0.05 (Measured from 10 Hz to 10 MHz)**

X. **Beam diameter : 1.5 to 2.5 mm**

XI. **Beam M2:<1.1 to 1.3**

XII. **Polarization : Linear, horizontal**

XIII. **Beam divergence :<1.0 mrad**

XIV. **Humidity control : system must allow for low humidity conditions within the oscillator portion of the cavity, providing smooth, no dropout mode locked performance throughout specified tuning range.**

XV. **System should be supplied with all necessary pump lasers, power supplies, water chiller, and other necessary accessories.**

(b) Regenerative Amplifier unit:

I. **Regenerative amplifier unit should be fully compatible with the above seed laser unit.**

II. **Pulse energy : > or equal to 5mJ**

III. **Pulse duration :<20-35 fs**

IV. **Central wavelength : ~800 nm**

V. **Pulse repetition rate : 1-5 kHz**

VI. **Power stability :<0.5% rms over 24 hours**

VII. **Pre-pulse contrast ratio :>1000:1**

VIII. **Post pulse contrast ratio :>100:1**

IX. **Mode quality : TEM_{00}**

X. **Beam M^2 :<1.25**

XI. **Polarization : Linear , Horizontal**

XII. **Beam Pointing stability :<10 urad rms**

XIII. **Beam Diameter (1/e2) : 9-12mm**

(c) Required Q-switched DPSS Pump Laser for Amplifier

I. **Q-switched pump laser must be based on diode-pumped technology to ensure long-term shot-to-shot pulse energy stability, and long lifetime.**

II. **Q-switched pump laser must not operate at more than 80% of current and satisfy the requirement of 5 mJ of pulse energy from regenerative amplifier unit at this value.**

III. **Q-switched pump laser should be fully integrated within the amplifier enclosure and should be on the same thermally stabilized platform to provide a thermally stable system i.e., to minimize sensitivity to changing environmental conditions such as air flow, humidity and temperature, and to minimize the beam walking.**

IV. **System should have a provision of using the 100% power output of the Q-switched pump laser for independent experiments whenever required. Suitable provision should be provided using flipper mirror.**

V. **Wavelength : 527nm**

VI. **Pulse Repetition Rate :1kHz**

VII. **Pulse Energy :> or equal to 30mJ @ 1kHz (must alsosatisfyspecification c-II)**

VIII. Pulse Energy Stability :< 0.5% rms

IX. Polarization : Horizontal

<u>One additional component is desired with the following specifications:</u>

I. Power meter to measure the pulse energy should be included in the quote. Power meter must have a large digital display with data logging facility, USB interface with windows compatible software, spectral coverage from 190 to 11000 nm, and measurable power range of 100 micro watts to 50 watts.

<u>Essential features:</u>

- **The pump laser, the seed laser and the regenerative amplifier should be in a one-box set up, and all three of the above should be sourced from a single factory/principal/manufacturing company.**
- **The Stretcher/compressor assembly should be "O-ring" sealed for enhanced stability and reliability to prevent contamination and for better grating lifetime**
- **Amplifier system should be fully tested in Accelerated Stress Screening chamber (including oscillator, pump, regen and stretcher/compressor) for optimum reliability and robustness. Results of the same must be provided with quotation.**
- **The complete system should be supplied with all necessary power supplies, closed-loop water chiller, filters, remote control, two laptop computers with control software, and other necessary accessories. No further accessories (other than the optical table, UPS and power outlets) should be required for safe and reliable operation.**

During installation of the product, the following specifications should be demonstrated onsite (at IITB Mechanical Engineering Department, Mumbai, India) for the equipment at a minimum:

(1) Output powers of the oscillator and the amplifier

(2) The simultaneous power output of ~150 mW from the oscillator (i.e., simultaneously with the amplifier being switched ON)

(3) Option of pump laser as a stand-alone option when the amplifier is NOT used

(4) Pulse width of the amplifier

(5) Bandwidths of the amplifier and the oscillator

(6) Pump power output

(7) Wavelength of oscillator, pump and amplifier

All necessary equipments/devices required to perform the demonstration on-site should be either included in the tender offer or brought by the technical installation engineer/personnel during installation.

Sr No. 13/ Reference No.14

Detailed Description of Item:

Mixed Signal Oscilloscope

Specifications for 2.5 GHz MSO

S.No.	Parameters	Required Specifications
1	Bandwidth	> 2.5 GHz
2	Number of Analog Channels	> 4
3	Number of Digital Channels	> 16 S
4.	Real Time Sampling Rate	> 10 Giga Samples/Sec on all analog channels, 20GS/s on any 2 analog channels at 12-bit ADC Resolution
5	Rise Time (10-90%, 50Ω)	< 166ps
6	Record Length	> 50 Million points on all analog channels
7	ADC Resolution	> 12 bits on all time base and 20GS/s sample rate
8	DC Vertical Gain Accuracy	± (0.5%)
9	Waveform Capture rate	> 750,000 Waveforms/sec
10	Maximum Input voltage for Analog and Digital Channels	Analog: 50Ω: 5 Vrms, 1 MΩ: 400 V max Digital: ±30V Peak

11	**Vertical sensitivity**	**1 MΩ: 1 mV/div to 10 V/div (or higher)** **50 Ω: 1 mV/div to 5 V/div (or higher)**
12	**Time base Range**	**20 ps/div to 1,000 s/div**
13	**Input Impedance**	**1M Ω + 2% with 15pF + 2.5pF** **50 Ω + 2%**
14	**Acquisition Mode**	**Real-time, Roll, Random Interleaved Sampling (RIS), Sequence**
15	**Measurements**	**Amplitude and timing measurements must be available. Mathematics functions such as FFT, derivative etc. must be present on all channels.**
16	**Trigger Types**	**Edge, Width, Glitch, Window, Pattern, Runt**
17	**Display type**	**Screen size > 15.4 inch with a resolution 1920 x 1080**
18	**Input/output Ports**	**LAN & USB**
19	**Accessories**	**As mentioned below.**
20	**Simultaneous usage of all 4 analog channels and 16 digital channels**	**Yes**
21	**Upgradation of Record Length up to 5000Mpts**	**Yes**
22	**Divide by 10 passive probes**	**Qty. 4**
23	**16 channel Lead set**	**YES**
24	**Operating System**	**Windows 10 or higher**
25	**Warranty**	**3 Years**

26	**Accessories**	**Extra-large gripper probe set. Ground extenders.** **Flexible ground leads. Power supply cable.**

Sr No. 14 / Reference No.15 (Revised)

Detailed Description of Item: Optical Table with Vibration Isolation

Technical specifications for Optical Table with Vibration Isolation (to be used with Raman Frequency (RF)/Optical (PL) Characterization System Upgrade)

1. Key Generic Requirements:

a. **The tenderer must provide an installation scheme showing the physical space (footprint) of the item(s) as well as space required for routine access and all installations including related accessories.**

b. **The vendor should have installed similar types of systems in centrally funded technical institutes or government research labs. Purchase order (PO) and user list should be provided as supporting evidence.**

c. **The compliance sheet should be provided by the vendor. The absence of the compliance sheet may result in the cancellation of the purchase order.**

d. **For each compliance, supporting evidence such as manuals and other necessary and supporting documents needs to be provided.**

a. **The vendor should have an Indian representative which can take care of the urgent troubleshooting or any queries on an urgent basis.**

e. **Installation and training of the system should be demonstrated.**

2. **(a) Technical Specifications (Generic):**

b. **The system is intended for use as base for the Raman Frequency (RF)/ Optical (PL) Characterization System Upgrade. The entire setup for the optical table should include**

i. **Optical table-top**

ii. **Vibration isolation legs (a set of 4)**

iii. **Air compressor**

All of the above items should be from the same manufacturer.

c. **The footprint required for the optical table-top is as following.**

i. **Length: 2400 mm (~8 ft)**

ii. **Width: 1500 mm (~5 ft)**

iii. **Thickness: 200-210 mm (~8 inch)**

d. **The height of the vibration isolation system should be between 650 mm and 750 mm.**

e. **The optical table-top should have a damped working surface made of stainless-steel with composite edge finish.**

f. **There should be a vibration monitoring capability preferably through a software over a USB interface.**

2. **(b) Technical Specifications (Specific):**

A. Optical table-top (Quantity: 1)

Following are must-have features:

- **Damping: Active damping**
- **Structural Damping range: 80-500 Hz or larger**
- **Flatness: = ± 0.1 mm over 600 mm sq**
- **Core construction: Trussed honeycomb**
- **Vibration monitoring: Active vibration monitor/controller compatible with USB interface with appropriate software and standalone operation**
- **Mounting holes: M6 in a 25 mm grid, individually sealed (non-corrosive) holes**
- **Working surface: ferromagnetic stainless steel**
- **Sealed Holes**
- **Mounting hole borders <25.4 mm**

B. Vibration isolation legs (Quantity - a set of four legs)

Following are must-have features:

- **Damping: Laminar flow damping**
- **Vertical isolation resonant frequency: 1 Hz**
- **Horizontal isolation resonant frequency: 1.5 Hz**
- **Vertical amplification at resonance: 10 dB or lower**
- **Horizontal amplification at resonance: 10 dB or lower**

- **Vertical isolation: >=90% (5 Hz) and >=98% (10 Hz)**
- **Horizontal isolation: >=85% (5 Hz) and >=95% (10 Hz)**
- **Maximum load capacity (per isolator): >800 kg**
- **Height adjustment range: >1 in**
- **Vertical relevelling accuracy: ±0.010 in or better**
- **Self levelling repeatability: better (lower) than ±0.3 mm**
- **Air pressure (Maximum): 85 psi**

C. Air compressor (Quantity: 1)

- **Quiet operation (30 dB or better at 1 ft)**
- **Intermittent Operation: Operates intermittently based on air usage; monitored by a sensor that maintains the reserve tanks preset minimum pressure.**
- **Includes High-grade air filter/regulator, safety valve, gauges, outlet cocks, fittings and drain.**

Sr No. 15/ Reference No.16

Detailed Description of Item: Femtosecond Laser

Note 1: All components are necessary unless 'OPTIONAL' clearly specified against them.

Note 2: In the technical bid, point by point list should be furnished to demonstrate requirements have been met

The system should have the following specifications and features:

1. **Laser Type: Diode-pumped solid-state laser**
2. **Lasing medium : Ytterbium (Yb)**
3. **Tuneable parameters: Repetition rate, pulse energy, average power**
4. **Maximum Repetition rate: ≥ 1 MHz (Tuneable)**
5. **Pulse picker : For pulse-on-demand (in-built)**
6. **Central wavelength (nm): 1030 10**
7. **Maximum Pulse Energy (µJ): ≥ 200**

8. **Minimum Pulse duration (fs): ≤ 350 (Full-width at half-maximum value)**
9. **Pulse duration : up to 10 ps (Tuneable)**
10. **Average Power (W) : ≥ 10 (Tuneable)**
11. **Beam quality(M^2): <1.2**
12. **Beam diameter (mm): ≤ 5**
13. **Divergence (mrad) : ≤ 1.1 times diffraction limited (for M^2<1.2 beam)**
14. **Pulse energy stability: ≤ 0.5% RMS over 24 hours**
15. **Power stability: ≤ 0.5% RMS over 100 hours**
16. **Pointing stability: < 25 µrad/ºC**
17. **Polarization : Linear, horizontal**
18. **Spatial Mode: TEM_{00}**
19. **Beam cross-section : Circular, with <10% variation in circularity**
20. **Power Input : 220-250 V AC, 50 Hz, with Indian standard plugs**
21. **Power Supply: Integrated (including AC-DC converter)**
22. **Operating ambient : 18 to30 ˚C**
23. **Storage ambient: 5 to 40 ˚C**
24. **Coolant: Water**
25. **External trigger control: Required**
26. **Ambient humidity: ≥ 50% RH (non-condensing)**
27. **Warranty: Minimum 1 year with full system warranty. Optional ex tendable warranty up to5 years.**
28. **The laser should be closed loop with water to air heat exchanger and without external water cooling.**
29. **Software to vary laser parameters should be included.**
30. **There should be a provision to add second harmonic generator in the future.**

Other important requirements:

31. **Please provide input on delivery period.**

32. **It is mandatory that it should be previously installed at least at one location in premier institutes and/or research labs of Government of India (such as IITs/ IISERs/ NITs/ DRDO labs/ DAE labs / CSRO labs / ISRO labs), which are using it for research purposes. As a proof, a support letter has to be furnished. Please provide contact addresses of previous installations of the system quoted for.**

33. **AMC cost after the warranty period must be mentioned in the quotation.**

34. **Door to door delivery paid for all components.**

35. **Installation and training should be provided free of cost.**

36. **During the installation, beam shape and output power of the laser has to be verified with appropriate instruments. These instruments have to be brought by the installation personnel during installation.**

Sr No. 16/ Reference No.17 (1000016228)

Detailed Description of Item:

GAS CHROMATOGRAPHY MASS SPECTROMETER

SCOPE & APPLICATION:

The GC-MS system should be capable of analyzing both quantitatively and qualitatively, with high resolution. It should be able to analyse Hydrogen gas, hydrocarbon gases and permanent gases such as C1, C2, C3, CO, CO2, N2, O2 etc using TCD detector.

GC-MS system with flow modulator should be used to identify components in Jet Fuel & Lube Oil. The GC should be of latest model/version from a reputed manufacturer with proven prior installations in India.

General System Configurations:

	General System Configurations:
	The GC system should meet the following minimum requirements but not limited to these. Bidder will quote the complete system with adequate flexibility to meet the stated scope of work.
	All quoted technical specifications are to be supported by company's original printed Technical Specification sheets.

	The GC should be equipped with electronic pressure and flow controller for inlets, detectors and auxiliary gases.
A.	**Column Oven:**
	1. Operation temperature should be from ambient+4 to 450 C. **2. Temperature set point resolution should 0.1 C** **3. Temperature cool down time from 400 C to 50 C should be less than 4 minutes.** **4. Maximum achievable temperature ramp rate: 120 °C/min** **5. The GC should support 20 oven ramps with 21 plateaus**
B.	**Split/Split less Capillary Inlet** **1. It should have split ratio up to 7500:1** **2. It should have optimized septum purge flow control to eliminate ghost peaks** **3. Maximum temperature 400 Deg C** **4. Total flow control/sensing up to 1000 ml/minute for hydrogen and helium.** **5. Total flow setting range 0 to 200 ml for Nitrogen and 0 to 1000 ml for Hydrogen.** **6. Split/split less inlets should have flow sensors for control of split ratio.** **7. Gas saver mode to reduce gas consumption without compromising performance.** **8. Electronic septum purge flow control to eliminate ghost peak**
C.	**Detectors: The instrument should have detector modules (One TCD &One MS) present with independent temperature and pneumatic control.**
I.	**Thermal Conductivity Detector (TCD):** **The TCD should have a minimum detectable level of 400 pg tridecane / ml with helium carrier gas.** **Linear dynamic range: 10^5+5%, and above with N2 carrier.**

	400°C maximum operating temperature

ii.	**<u>Mass Spectrometer Specifications (MS):</u>** **Latest single quad EI MS must have a capacity to show the instrument detection limit of 1.5 fg or less for 10 fg/ul OFN for ion 272.** **MS system must have the SCAN sensitivity of 300:1 or better for OFN standard of 0.1 pg/ul, scanning from the range of 50-300 with nominal ion of 272.** **MS must come with series II triple axis detector with high energy dianode with long life electron multiplier.** **The Mass Filter and Detector should be placed on the same plate as Ion Source for better accessibility.** **The Mass Spectrometer shall have an electronic scan rate of 20,000 u/sec or better.** **The mass spectrometer must use an ion source where the metallic parts are constructed from inert material and Ion Source temp controllable from 150 to 300 degrees C.** **Stainless steel or coating the metallic parts with an inert material is not preferred.** **Mass Spectrometer should utilize a Quadruple Mass Filter consisting of a monolithic quartz structure without a quadruple consisting of separate rods. The Quadruple is to be independently heated and its temperature is to be user selectable from 106 to 200 deg C.** **Mass Range for the MS must be from 1.6 to 1050 amu or better.** **The mass spectrometer shall have the capability to create 100 SIM ion groups with up to 60 ions per group.** **The high-vacuum region must utilize an air-cooled high vacuum turbo pump with a minimum pumping speed of 255 L/s (Helium) Turbo Pump with 2.5 m3/hr mechanical pump or better.** **System should come with sleep/wake mode to conserve carrier gas and electricity.** **When Vent Cycle is started, GC recognizes and optimizes the column flow to cool down the MSD faster.**
D.	**Columns:**

	The unit shall have the required number of suitable columns to carry out application mentioned in scope. **The following columns or equivalent should be supplied along with system.** **Two capillary columns: 30m x 0.25mm non-polar, 5m x 0.25mm polar** **Three packed column for permanent gas separation**
E.	**Electronic Pneumatic Control (EPC)** **1. The equipment should have full electronic pressure control for all inlet and detectors.** **2. The EPC should have Atmospheric pressure compensation sensor to compensate for altitude and ambient temperature variation.** **3. Pressure adjustment in increments of 0.005 psi** **4. Pressure sensors accuracy: <±2% full scale, Repeatability: <±0.05 psi and** **Temperature coefficient <±0.01psi.** **5. Retention time repeatability should be less than 0.001 minutes.** **6. It should have facility for pre programmed leak test.** **7. Carrier and make up gas setting selectable for H2, He, N2, Ar**
F.	**Communication system for external control of GC parameters: The instrument should start its operation with a single switch. The operating switch should purge, stabilize, inject and start the programme both in gas chromatograph and in the data processor/integrator simultaneously.**
G.	**Data Acquisition, Processing and Interpretation:** **The GC MS software provided for equipment operation, control and data acquisition should be compatible with data processor. The vendor should install the latest version of original software with license certificate along with copy from the original manufacturer.**
H.	**GC System** **GC system must be capable of performing comprehensive GCxGC on the entire sample.** **I. Modulator system**

	The GCxGC modulation must be Capillary Flow Technology based in order to achieve modulation starting from C1. **ii. Data Processing Software** **The GCxGC system should include a complete data processing software package capable of:** **Automated peak location based on expected peak width and a signal-to-noise threshold.** **Automated peak area calculations based on automated combination of modulated peak slices. Automated analyte quantification.** **The GC-MS system should include software capable of displaying: Contour plots; Surface plots; Wire mesh plots etc.** **The data processing package should have classification feature for grouping compounds of similar chemical functionality.**

Sr No. 17/ Reference No.18

Detailed Description of Item: Stopped-Flow Fluorescence Spectrometer

Light Source: 450W ozone free Xe source or better for doing steady state fluorescence measurement with power supply.

Optics: The system should be a mirror based for focusing at all wavelengths and precise imaging for micro samples

Excitation Spectrometer: Czerny-Turner design based double Spectrometer with intermediate slit or better with 1200 g/mm gratings blazed between 300-350nm or better

Emission Spectrometer: Czerny-Turner design based single Spectrometer or better with 1200 g/mm gratings blazed between 500-550nm or better

Dual Channel Fluorescence Detection

Excitation and Emission wavelength Range: 200-950nm or better

Bandpass: The System should have continuously adjustable entrance and exit slits operated under computer control

Wavelength Accuracy: +/- 0.5 nm or better

Signal to Noise Ratio: Minimum 30,000:1 (RMS Method), >15,000:1 (FSD Method) using water Raman signal at excitation at 350 nm, emission at 397nm, Bandpass 5 nm and 1 sec integration time. Vendors have to mention both FSD and RMS values.

Reference Detector: Photodiode detector should be provided

Emission Detector: Photomultiplier tube detector should cover the wavelength range from 250-850 nm and should operate in photon counting electronics mode.

Sample compartment: The sample compartment should be enough space to accommodate cryostat in later stage

Cuvette: Minimum of one 4 mL, 1 cm x 1 cm quartz cuvette

Solid sample holder: One number of Solid sample holders should be provided for thin film, powders, and pellets.

Order Sorting Filters: Suitable order sorting filters in the range of 370nm, 399nm, 450nm, 500nm and 550nm along with holders should be offered

Variable Temperature Accessory: Peltier accessory should be provided for the temperature range from -15°C to +105°C or better.

Anisotropy Accessory: Automated dual polarizers should be provided for doing anisotropy measurements. Fluorescence Polarization/Anisotropy. T-Format measurement of Fluorescence Polarization and Anisotropy.

Stop flow accessory: Should be provided for rapid kinetic measurements. Optimized for both absorbance and fluorescence detection without the need for reconfiguration. Electronic Control Unit with Monochromator

Stepper Motor Unit
Unsurpassed sensitivity: ultrastable 75W xenon light source
Power supply for Tungsten, Xenon & combined - Mercury/Xenon Lamps
Temp range -20 to 100 deg C
Fluorescence Enhancement Kit, Beam Splitter

Long Optical Rail & Tool Kit,
Fast A/D Converter (12 bit,1.25 MHz)

Future upgradation: The system should be field upgradable to Time Resolved measurement with TCSPC attachment and NIR measurements upto 1500nm or better.

Software and Computer: A suitable fluorescence analysis software and branded computer should be supplied along with the system

On Line 3 KVA UPS with half an hour back upto support the complete system

Warranty: Minimum one year from the date of installation and additional three years AMC.

N2 Gas Cylinder and Double Stage Pressure Regulator (should be quoted and will be optional)

A DETAILED COMPLIANCE STATEMENT WITH RESPECT TO ABOVE MENTIONED SPECIFICATION SHOULD BE ENCLOSED ALONG WITH THE OFFER.

Sr No. 18/ Reference No.19

Detailed Description of Item :19.

Technical Specifications for Fully automated Robotic workstation

Fully automated Robotic workstation equipped with hardware and operation software;

Capable of faster investigation of Reaction , Reagent and Molecule space

Integrated with reactor block in inertizable system for library synthesis and route scouting in glass disposable vials, suitable for e.g.:

Organic / organometallic / ligand library synthesis

Ambient pressure catalysts screening, e.g.CC-/CN-coupling

Route scouting / early process research

Kinetic reaction profiling

Reaction screening / late-stage drug discovery, 48 x 8 total volume

Poly-/oligosaccharide library synthesis and 1st stage optimization

Array reactor block shall be equipped with:

48 x 8mL disposable glass vials reactors with below capabilities

heating / cooling (-20 to 150ºC)

refluxing

mixing by shaking for liquid-phase and solid-phase chemistry

vacuum for e.g. inertization and solvent evaporation

Optional: filtration (for future expansion)

The workstation should include an exchangeable robotic tools for e.g. gravimetric & volumetric dispensing of solids and volumetric dispensing of liquids as and when required during course of reaction

Should have a provision for automatic reactor opening during reaction for automated addition of solid reagents or solvents directly into the reactors while under vortex, whenever required.

The system should include a 4 channelLiquid Handling Unit for automated Liquid dispensing while the reactors are under stirring and Heating/cooling.

Accuracy: < 0.40% per stroke

Precision: < 0.12% per stroke

Max. Viscosity: < 100 mPa·s

Should be equipped with independent needles for volumetric dispensing and aspiration of low viscous liquids equipped with 4 x independent high-resolution syringe pumps with corresponding 10mL syringes, (other sizes of 1, 10 and 25 ml should be optionally quoted) and 4 septa piercing stainless steel needles should be supplied. Optionally peek coating to be quoted

The dispensing unit should include a multi-way & port valves for connecting up to min 14 different solvents

Rinse stations for the needles inside / outside rinsing are needed

The workstation should include one Solid dispensing handling tool for gravimetric dispensing directly into conditioned, measured, stirred reactors

Should be integrated with 20g balance with resolution 0.1mg

independent source material 8 x 20mL containers to avoid cross contamination

Containers for multiple source materials and the holding station

There should be provision on the workstation to hold the solid powder containers.

There should be a provision for Liquid transfer and Solid Dispensing protocols such as 1-to-1, 1-to-many, many-to-1 and many-to-many basically provision of multiple way transfer of solution/powder from sample container to reactor

The workstation should include Sample /Reagent racks for holding 80 x 8 ml and 30 x 60 ml vials including vials

Should include two separate cryostats one for the reactor block and one for the reflux circuit

Vacuum pump and condenser for Inertisation, Evaporation, Degasing applications is required

Temperature (0-60 °C) and humidity (0-100%) monitoring facility should be included

The workstation should come with operation software to control the experiments and the operation of the workstation with perpetual licenses

Operation software shall be intuitive, easy to use and enable to configure instrument changes, create/change experiment workflows and operation parameters

Operation software shall enable visualization data acquisition, the data integration

Optional: operation software that enables the 3rd party data access such as analytical instruments and AI/ML with capability of additional software engineering programing;

Optional: work up (solid and liquid/liquid phase extraction racks to be quoted

Optional: capability of upgrading to higher or lower measuring ranges fore.g. 2mL, 20mL, 100mL total volumes should be quoted

Safety feature provision for shutdown in case of emergency is needed

CE compliance is required

One year warranty

Sr No. 19/ Reference No. 20 (1000016008)

Detailed Description of Item :

Magnetic Property Measurement System

Description:We intend to procure a fully automated computer-controlled cryogen-free SQUID based Magnetic Property Measurement System operational in temperature range ≤ 1.8 Kto ≥ 1000K and magnetic fields up to ± 7 Tesla or higher. The instrument should have strong track record for the specified measurement options including but not limited to the measurements of bulk, thin-film, single crystal and nano-particle based organic, inorganic samples.

Base System & Cryogenic specifications:

System must accomplish the initial cool-down directly from Helium gas within 40 hours (maximum). Provide supporting data and log files with the offer. Demonstration will be asked during technical evaluation.

We prefer the system which can operate with as little liquefied helium as possible. The maximum quantity of liquid helium collected through condensation of the helium gas must not exceed 17 liters when the system is operating at its full capacity. Vendor must mention the He reservoir capacity.

Cool down should be totally automated without the need of any kind of manual intervention. There should not be any need of the external vacuum pump etc. to complete the process.

System should have two He gas bottles connected simultaneously with the automatic switch over when first bottle is empty. This is essential to make sure that the system can be run without needing to change the cylinder for longer time.
System should show the status display of the Cylinder.

Magnet Control Specifications:

Vapor cooled Superconducting magnet with longitudinal field in the range of ± 70 kOe or Higher

Field uniformity ±0.01% over at least 4 cm.

Remanent field: 5 Oe or less when oscillating from full field to zero.

System must achieve zero field to 7 tesla in < 2 minutes. Provide supporting data with data files with the offer. Demonstration will be asked during technical evaluation.

Field charging resolution must be 0.35 Oe or better.

System should have a magnet reset option.

2. **Temperature Control Specifications:**

Temperature range of ≤ 1.8K or lower to ≥ 400 K and ≥ 1000 K with high temperature option.

Maximum system cooling rate should be ≥ 28 K/min. Provide supporting data with data files with the offer. Demonstration will be asked during technical evaluation.

300 K to 10 K stable should be achieved within 17 minutes &10 K to 1.8 K stable must be achieved in ≤ 5 minutes. Provide supporting data with data files with the offer. Demonstration will be asked during technical evaluation.

System must feature a finely tuned flow impedance along with sophisticated temperature control software to allow continuous operation at 1.8 K as well as smooth temperature control through the 4.2 K liquid helium boiling point.

System should not use any inefficient techniques like needle valve adjustments to achieve low temperature.

At least three thermometers should be available in base system.

System temperature stability must be ±0.5 % or better. Vendor must provide the temperature stability data @ 1.8 K for minimum 48 hours with supporting log files. Without log data, claim will not be accepted.
Data for Thermal Cycling for 5 times. I.e. 400K-1.8K back to 400K and 1.8K for 5 or more cycles in temperature vs time format must be provided. Provide supporting data with data files with the offer.

3. **DC Measurement Mode:**

- **DC measurement temperature range from 1.8 K to 400 K and 300 K to 1000 K.**
- **Appropriate sample holder compatible with the above temperature range mentioned must be provided by the company.**
- **The sample rod should possess low thermal expansion**
- **Different type of sample holders compatible for bulk magnetic measurements (Example: metal oxides) and discrete molecular samples (Single-molecule-Magnet)**
- **Sensitivity of ≤ 5 X 10^{-8} emu at zero field for ≤ 2500 Oe. Full field sensitivity should be better than 6 X 10^{-7}emu in DC Mode.**
- **Variable drive amplitude from 0.1 to 7 mm or bigger.**
- **DC SQUID scan measurements should collect at least 700 points or more (SQUID output vs sample position) to fit and calculate each measurement curve to maximize accuracy. Multiple averages should utilize multiple curves. Provide supporting data.**
- **Vendor must provide a high-resolution MH Loop measurement over +/7 T, with ≥ 500 data points acquired within 4 hours and rms noise should be less than 1 x 10-6 emu. Vendor also has to provide datafiles for the same. Demonstration will be asked during evaluation.**
- **Vendor must present at least 10 publications (not more than a year old) with measurement data showing 1.8 K or lower to 400 K complete temperature range in DC Mode in support of the claims.**

4. **AC Susceptibility Measurement:**

- **AC Susceptibility measurement temperature range from 1.8 K to 400 K. AC frequency range must be 0.1 Hz to 1 kHz or higher**

- **Peak AC Amplitude of ≤ 0.1 Oe to ≥ 10 Oe**

- **AC Moment Sensitivity must be 5 x 10-8 emu or better over the entire field range Phase Angle Accuracy must be ≤ ±0.5° over the entire AC measurement frequency spectrum. Please provide supporting data.**

- **Please provide AC Susceptibility measurement data from 0.1 to 1 kHz with 1 Oe amplitude for the Cobalt ferrite (CoFe2O4) nanoparticles in mineral oil. Data files will be asked for confirmations.**

- **AC measurements must be supported up to 1000K with oven option. Provide the AC measurement data for High temperature measurement. Datafiles and demonstration will be asked during evaluation.**

- **Vendor must provide at least 10 recent publications (within a year) in support of the AC Susceptibility data acquisition from 1.8 K to 400 K measurement and accuracy of the quoted item**

5. **High Temperature measurements:**

- **The oven option must be capable of measuring AC, DC and VSM measurement option from 300K to 1000K. Provide the supporting information for the claimed temperature range.**

- **Temperature Accuracy should be ≤ 2% after stabilizing**

- **Provide the high temperature measurement data with all AC, DC and VSM measurements modes separately in support of the claim. Data files will be asked.**

- **Vendor must provide at least 10 recent publications (within a year) in support of the high Temperature measurements up to 1000K in DCmode,10 publications (within a year) for high temperature VSMmode and 10 publications (within a year) for high temperature AC measurement using the quoted item.**

6. **Sample rotator:**

- **Temperature range from 1.8 K to 400 K.**

- **This option must facilitate stepper motor fully integrated into the sample rod to allow fully automated sample measurements as a function of angle.**

- **Rotation Range must cover full 360°.**

- **Angular Step Size of ≤ 0.1°**

- **It must be compatible with above options. i.e. DC Scan & AC Susceptibility**

- **System software should be able to control the sample holder plate with the rotator motor, allowing fully automated sample measurements as a function of angle.**

- **Provide the Angle dependent data measured at low temperature (≤ 5 K). Data files will be asked**

- **Vendor must provide at least 10 recent publications (within a year) in support of the angle dependent measurements to support the features and accuracy of the quoted item.**

7. Accessories:

- **Vendor should offer suitable UPS (with 30% more output than the maximum power utilization expected by the instrument, with a minimum battery backup of 60 min or more) and compatible Chiller with the offer. It should be compatible with Indian voltage (220 V/50 Hz)**

8. Other important points:

- **We are looking for a turn-key solution and hence the vendor is responsible for the full installation, commissioning, testing and trainings.**

- **The vendor must provide a detailed compliance statement with respect to each technical specification in the tender document duly supported by the manufacturer's literature or documents. Any other claim will not be accepted and may lead to rejection of the bid.**

- **Vendors may be asked to demonstrate all mentioned specifications in similar Cryogen-free system installed in India within 2 weeks of the technical bid opening date. Travel expenses should be borne by the vendor.**

- **Only the reputed manufacturer will be considered. At least 15 similar Cryogen-Free SQUID based measurement systems should be installed in India. A user list with the similar systems to be provided.**

- **Vendors must provide "at least 10 customer satisfaction letter/certificates from Indian Institutes/Labs"where similar measurement systems are installed and working satisfactory. Document must not be older than 1 year. "Installation reports are not a valid document for the said purpose"**

- **Warranty: minimum 5years from the date of installation and OEM/vendor should give in writing additional 8-10 years of comprehensive maintenance support with additional charges as per the prevailing rates. Instrument which are likely to be obsolete in this time frame should not be quoted.**

- **Installation and adequate Training should be carried out by the qualified service engineers at user site. Vendor must furnish the details of the trained service engineers stationed at Mumbai to ensure quick and regular support.**

- **Standard samples to be provided by the company for testing the instruments at the time of installation on site to the quoted accuracy in the given technical specifications for the demonstration of the performance of the equipment.**

- **Guaranteed specifications to be demonstrated at the time of installation. Any necessary standard samples for that purpose should be brought by the service engineers.**

- **Printed literature and published papers in support of all compliance to the prescribed specifications should be provided.**

- **The vendor must provide a compliance statement IN TABULAR FORM with respect to each technical specification in the tender document duly supported by the manufacturer's literature and published papers. Any other claim will not be accepted and may lead to rejection of the bid.**

- **Technical evaluation by the institute may include demonstration to verify functionalities and capabilities of the system quoted**

Sr No. 20/ Reference No.21 (1000016226)

Detailed Description of Item : ATOMIC FORCE MICROSCOPE

1. **Instrument Resolution**

- **The instrument should achieve atomic, lattice resolution in AC mode and contact mode imaging.**

- **Large scan-range scanner with up to (XY) 120µm x 120µm in closed loop to allow large survey scan.**

- **Ability to zoom-in to get high resolution images at a region of interest.**

2. **Instrument Geometry**

    - **Separate XY scanner and Z scanner.**

    - **Single rigid frame housing cantilever holder and the optical lever assembly (laser, optics and detector).**

    - **Capable of handling sample sizes up to 80mm (dia) and 10mm thick (expandable upto 25 mm).**

3. **Operating ModesThe microscope should be capable of following scanning modes:**

- **Contact Mode**

- **Two frequency mode**
- **Resonance tracking mode**
- **Electric Force Microscopy (EFM)**
- **Force Curve Mode**
- **Force Mapping Mode (Force Volume)**
- **Force Modulation**
- **Frequency Modulation**
- **Fluid imaging**
- **Kelvin Probe Force Microscopy (KPFM)**
- **Lateral Force Mode (LFM)**
- **Magnetic Force Microscopy (MFM)**
- **Nanolithography/ Nanomanipulation**
- **Phase Imaging**
- **Tapping Mode**
- **Tapping Mode with Q-control**
- **Piezoresponse Force Microscopy (PFM)**
- **Switching Spectroscopy PFM**
- **Dual AC Resonance Tracking PFM**
- **Vector PFM**
- **Vertical PFM**
- **Lateral PFM**
- **Imaging on piezo materials in the vertical PFM, lateral PFM, vector PFM and lithography modes.**
- **Simultaneous remnant and applied voltage hysteresis loops on ferroelectric materials and switching spectroscopy mapping (while measuring contact resonance frequency, PFM drive amplitude, PFM phase and tip-sample dissipation/Q-factor).**
- **Pulse-relaxation measurements (while measuring contact resonance frequency, PFM drive amplitude, PFM phase and tip-sample dissipation/Q-factor)**

- **The instrument must exhibit extremely low crosstalk between the tip-drive voltage and the measured deflection. The measure of crosstalk is defined as follows:**

- **The system control must allow the user to route the AC bias either to the tip or the sample through software control.**

- **The PFM control software must include a variety of PFM spectroscopy modes in various complexity levels to perform user defined bias curves.**

- **The software must include sufficient analysis routines within the data analysis environment to eliminate the need to export, re-import into third party software, or interpret the exported data scales**

- **High resolution mode for imaging delicate soft samples in both air & liquid environment while maintaining resolution & clarity.**

- **Conductive AFM at sample bias range of -10V to 10V, with flexibility for user-specified waveforms.**

- **CAFM with output channel gains of 1uA/V1nA/V in the range of 4 pA to 10 µA.**

4. **<u>Optical Lever Arm: Light Source and Photodetector</u>**

    - **The instrument optical lever arm should employ a low coherence light source (a super luminescent diode).**

    - **The instrument should use an infrared SLD for the optical lever arm.**

    - **Beam used for deflection detection approaches the probe at >20 degrees off vertical relative to the sample.**

5. **<u>System Scanner</u>**

    - **System should scan the sample in XY and the tip in Z, with independently controlled piezo stack and flexure stage.**

    - **System should include a closed-loop XY scanner with a range of 120 µm.**

    - **XY sensor noise <0.6nm in a 0.1Hz to 1kHz bandwidth (closed loop)**

    - **System includes a closed loop Z scanner with a range of 15 µm (extendable upto 40 µm).**

    - **Z sensor noise <0.25nm in a 0.1Hz to 1kHz bandwidth (closed loop).**

- **<u>System Noise</u>**

- **DC Height Noise must be less than 60pm ADev in a 0.1Hz to 1kHz BW (<20pm in quiet environments). DC Height Noise is defined here as the apparent movement of a moderately stiff cantilever (Olympus TR800,100 µm, k=0.61 N/m, or equivalent) in static contact with a hard surface with the Z feedback loop turned down to limit the bandwidth to below 0.1Hz.**

6. **<u>System Optics</u>**

- **Sample view should be through top View illumination and built-in CCD camera with 10 X objective located in the head. Field of view should be switchable between 720 and 240 microns.**

7. **<u>Controller and Electronics</u>**

- **Should employ 24-bit digital-to-analog converters (DACs).**
- **Thermal tunes of the cantilever extending up to 2 MHz.**
- **Digital Q-control in the range 2 kHz – 2 MHz.**
- **The system must include software controlled relays for the X, Y and Z high voltage supplies and the laser power.**
- **The system should provide auto-configuration of external hardware and accessories without the need for parameter files.**
- **The system must include a user programmable control knob that can be used to fine tune and adjust all scan parameters.**
- **Heads, scanners, probe holders and optional environmental control cells should be "plug and play".**

08. <u>Software</u>

- **Control and analysis must be user-programmable natively in an entirely open-source software programming language.**
- **System software should include an one-click configuration tool that sets up the software for standard and user-defined operation modes, such as AC imaging in air and liquid, contact mode, EFM, KPFM, PFM, force measurements, etc.**
- **The data acquisition system must be capable of recording individual image sizes of 8000x8000 pixels.**
- **AFM control software environment must include 3D rendering technology for advanced image display.**
- **Must include drift compensation software.**
- **Must include a feature that automatically calibrates the cantilever sensitivity (deflection sensitivity/INVOLS) and spring constant by simply selecting the probe type and clicking a button.**

- **Software includes a feature that automatically optimizes the imaging gain and setpoint for AC Mode (tapping mode) operation**

09. Instrument Isolation

- **The system includes a thermally- and acoustically-isolating enclosure.**
- **The system must include a vibration isolation table suitable for the system performance and specifications.**

10. Warranty

- **The instrument should be supplied with one year warranty & extended warranty for 2years.**

Sr No. 21 / Reference No.22

Detailed Description of Item :

Specs for Microwave Synthesis System

Microwave hardware Microwave cavity- ~18/8 stainless steel housing with multi-layer PTFE coating Large microwave cavity ~ 43x40x41(h) cm (~ 70 L)

Inlet/Outlet ports Removable large flange with ~ 36 mm ID plus additional ports on side walls

Chassis- Protected against acids and solvents with polymer coating

Door- Completely made of stainless steelSelf-resealing pressure responsive doorMultiple independent safety interlocks to prevent microwave emission in case of improper closure or misalignment

Coloured backlit logo indicates the process status Exhaust system

Built-in, located at the rear of the cavity and separated from electronics to prevent

Microwave emission - Dual magnetron system with rotating diffuser for homogeneous microwave distribution Two ~ 950 watt rated magnetron, for a total of 1900 watt

Continuous PID- controlled microwave emission at all power levels

Appropriate Emission and safety norms - Advanced featuresBuilt-in software controlled digital camera Built-in turntable motor kitBuilt-in magnetic stirringBuilt-in infrared temperature sensor

Control terminal touch-screen, ~ 6.5" TFT display ~ 640x480 VGA resolution with ~ 64k colors

5 USB ports; 1 RS-232 port; 1 LAN port; 2 video ports

Operating software - At least English

Operator manual in English language

Weight: ~ 80 kg

Power supply: 230V/50Hz 3,5 kwattClassic Glassware package should include Glassware kit with 500 mL flask p/n SGL0230; Glass connecting tube 450 mm p/n GLS0009/A; Stopper for glass reactor p/n 70151 (minimum of one number each)

HIGH-PRESSURE PACKAGE (FOR PARALLEL SYNTHESIS UNDER PRESSURE)

Vessels volume: ~ 100 mL; temperature ~ 300°C;

pressure ~ 100 bar, includes:

Rotor body (at least 1 no)

Standard segment complete (at least 15 no)

Workstation complete (at least 1 no)

Tension wrench with adapter (at least 1 no)

Stirring bar (at least 1 no)

Segments labels numbers 1-15, purple-white (at least1 no)

Required temperature control by fiber optic

Easy TEMP direct contact-less temp control in all vessels

OPTIONAL ACCESSORIES (at least one number each)

Solid Phase reactor complete 50, 300, 2500, mL, with below items for each reactor

{Solid-Phase reactor complete

should includeCover for glass vessel

Glass vessel 300 mL

Support for glass vessel

Stirrer D 30 mm x 120 mm }

Pre-installed Solid-Phase reactor turning motor assembly

Optional Accessory

Combivac Module

Multi interface box connection

Minimum 3 years (preferred 5 years) of comprehensive warranty

Sr No. 22 / Reference No.23

Technical Specifications for Scanning mobility particle sizer:

1. **Particle Concentration Limit: Up to 10,000,000 particles/cm^3 (10,000,000,000 particles/ liter)**
2. **Particle size range: 50 to 1000 nm**
3. **Size channels: up to 16/user-adjustable size channels**
4. **Zero count: <1 count per minute**
5. **Sampling time: ≥ 1 second/user-adjustable**
6. **Aerosol Flow rate: 0.5 to 5 cm^3/min**
7. **Electrical power requirements: 220-240 V, 50 Hz, Single phase input supply.**
8. **Size Range Detected: from 1 nm to 1000 nm**
9. **Size Resolution: up to 192 channels**
10. **Measurement time: <10 to 300 s selectable**
11. **Working Fluid: n-butanol (n-butyl alcohol)**
12. **Discrete particle measurement: works well for multi-mode samples**
13. **Optical properties: Independent of particles and fluid**
14. **Environmental Conditions: Operational Temperature: 0 to 45°C, Humidity: 0 to 90% RH, non-condensing, Storage temperature: -20 to 60°C.**

Warranty: 2 years

1. **Particle size range: Min. Detectable particle : 50 to 1000nm Max. Detectable particle : up to 1000 nm.**

2. **Concentration range : 0 to 10,000,000 particles/cm^3**
3. **Minimum displayable concentration value: 1 particle/cm^3**
4. **Concentration accuracy: ± 20%**
5. **Resolution: Up to 192 channels**
6. **Response Time: <10 to 300 sec selectable**
7. **Aerosol medium: Air**
8. **Software: Not specified**

Technical Specifications for Scanning mobility particle sizer:

1. **Particle Concentration Limit: Upto 10,000,000 particles/cm3 (10,000,000,000 particles/ liter)**
2. **Particle size range : 0 to 1000 nm**
3. **Size Resolution: up to 192 channels**
4. **Size channels: up to 16/user-adjustable size channels**
5. **Zero count : <1 count per minute**
6. **Sampling time : > 1 second/user-adjustable**
7. **Flow rate: 0.5 to 5 cm3/min**
1. **Electrical requirements: 220-240V, 50 Hz, Single phase input supply.**
2. **Concentration Range: 107 particles/cm3**
3. **Size Range Detected: from 1 nm to 1000 nm**
4. **Resolution: up to 192 channels**
5. **Measurement time: <10 to 300 s selectable**
6. **Working Fluid: n-butanol (n-butyl alcohol)**
7. **Discrete particle measurement: works well for multi-mode samples**
8. **Optical properties: Independent of particles and fluid**
9. **Aerosol Medium: Air only**

10. **Environmental Conditions: Operational Temperature: 0 to 45°C, Humidity: 0 to 90% RH non-condensing Storage, temperature: -20 to 60°C**

Technical Specifications for Scanning mobility particle sizer:

1. Particle size range: Min. Detectable particle : 1 to 1000nm

2. Max. Detectable particle : up to 1000 nm.

3. Concentration range: 0 to 10,000,000 particles/cm3

4. Minimum displayable concentration value 1 particle/cm3

5. Concentration accuracy: + 20%

6. Resolution: Up to 192 channels

7. Response Time: <10 to 300 sec selectable

8. Environmental operating conditions Ambient temperature: 10 to 35°C

9.Storage temperature : -40 to 70°C

10. Aerosol Flow rate: 0.5 to 5 cm3/min

11. Aerosol medium: Air

12. Power Requirement: 220-240 V, 50 Hz, Single phase input supply.

13. Software: Not specified

Sr No. 23/ Reference No.24

Technical Specifications for Optical Particle Sizer :

1. **Particle Concentration Limit: Upto 3000 particles/cm^3 (3,000,000 particles/liter)**
2. **Mass concentration: 0.001 to 275000 ug/m^3**
3. **Particle size range : 0.3 to 10um**
4. **Size Resolution : 5% at 0.5 um per ISO 21501-01/04**
5. **Size channels : up to 16, user-adjustable size channels**
6. **Zero count : <1 count per minute**

7. **Sampling time : ≥ 1 second, user-adjustable**

8. **Flow rate: 1.0 L/min: ± 5% accuracy (meets ISO 21501)**

9. **Sheath 1.0 L/min**

10. **Environmental Conditions:Operational Temperature: 0 to 45°C, Humidity : 0 to 96% RH, non-condensing Storage temperature: -20 to 60°C**

11. **Aerosol Medium: Air only**

12. **Data storage: 5MB on-board memory (30,000 samples)**

13. **Communications:**

Interfaces: USB, Ethernet or USB flash drive

Digital display : 5.7 in color touchscreen w/graphical display

Analog output : 0 to 5V or 4 to 20mA. User selectable out-put and user selectable

14. **Alarm out : Visual indication, audible buzzer, relay or switch, user selectable set point**

15. **Gravimetric Sampling: 37 mm filter inside standard removable 37 mm filter cartridge**

16. **Vacuum Source: Internal pump**

17. **Light Source: Long lasting laser diode**

18. **Power: AC Adaptor 100-240 VAC, 50/60 Hz, 15W**

Technical Specifications for DUSTTRAK DRX AEROSOL MONITOR (Hand held):

1. **Particle size range: 0.1 to 15um**

2. **Aerosol concentration range: 0.001 to 150 mg/m^3**

3. **Size Segregated Mass Fraction: for PM1, PM2.5, Respirable, PM10 and Total Resolution: ±0.1% of reading or 0.001 mg/m3, whichever is greater**

4. **Zero Stability: ±0.002 mg/m3 per 24 hours at 10 sec time constant**

5. **Flow Rate: 3.0 L/min**

6. **Flow Accuracy: ±5% of factory set point, internal flow controlled**

7. **Temperature Coefficient: +0.001 mg/m3 per °C**

8. **Operational Temp: 32 to 120°F (0 to 50°C)**

9. **Storage Temp: -4 to 140°F (-20 to 60°C)**

10. **Operational Humidity: 0 to 95% RH, non-condensing**

11. **Time Constant: User adjustable, 1 to 60 seconds**

12. **Data Logging: 5 MB of on-board memory (>60,000 data points) 45 days at 1 minute logging interval**

13. **Log Interval: User adjustable, 1 second to 1 hour**

14. **Weight: Handheld- with battery, Desktop- 3 batteries**

15. **Communications: USB (Host and Device) and Ethernet. Stored data accessible using flash memory drive**

16. **Power–AC: Switching AC power adapter with universal line cord included, 115–240 VAC**

17. **All displayed Dust mass: Handheld 0.001 to 150 mg/m3 , Detection principle/Sensor type: 90° light scattering**

19. **Volumetric flow rate: 3.0 L/min+±5% of factory set point, internal flow controlled**

20. **Operating conditions: 33 to 120°F (0 to 50°C), 0 to 95% RH, non-condensing**

21. **Environmental Conditions:**

Operational Temperature: 0 to 45°C

Humidity: 0 to 90% RH, non-condensing

Storage temperature: -20 to 60°C

22. **Aerosol Medium: Air only**

23. **Communications: Interfaces: USB, Ethernet or USB flash drive**

24. **Gravimetric Sampling: Removable 37 mm cartridge (user supplied)**

25. **Power: AC Adaptor 100-240 VAC, 50/60 Hz, 15W**

Technical Specifications for Aerosol Neutralizer:

Model: 3077A , 370 MBq (10 mCi), ^{85}Kr 1/2 life 10.8-year

Flow rate: 5 L/min

Sr No. 24 / Reference No. 25.

Technical Specifications for Beta Attenuation Monitor:

1. **Operating Principle: Measures ambient particulate concentrations using beta ray attenuation**

2. **Measurement Cycle Time: 1 hour**

3. **Flow Rate: 16.7 liters per minute, actual or standard flow conditions**

4. **Filter Tape: Glass fiber filter tape, 60 days of operation per roll**

5. **Beta Source: 14C (carbon -14), 60 µCi ±15 µCi (2.22 MBq)**

6. **Beta Detector Type: Photomultiplier tube with organic plastic scintillator**

7. **Operating Temperature: 0º to +50ºC (inside shelter)**

8. **Ambient Temperature: 40º to +55ºC (BX-596 AT sensor) -30 to +50C (BX-592). Extended range sensors**

9. **Sensor Ambient Humidity: 0 – 90% RH, non condensing**

10. **Range Sample Humidity: Actively continuous inlet heater module, 10%-99% RH Set Point**

11. **Control Enclosure: Weatherproof enclosure or shelter is required**

12. **Power Supply: 100/120 or 220/240 VAC and 50 or 60 Hz**

Sr No. 25/ Reference No.26.

Detailed Description:

Cross Beam/Dual Beam with Laser attachment (Integrated Eds+Ebsd+Wds) And Thermodynamic In-Situ Stage. Multi-beam (Field emission electron, Gallium ion and femtosecond laser with gas injection system for sub micron machining and deposition. And in situ thermo-mechanical structural property characterization in vacuum while being observed by Scanning electron microscope.

Item	

A	**Field Emission Scanning ElectronMicroscope** **Focused IonBeam** **Multi gas injectionsystem**
1	**Field Emission Scanning Electron Microscope**
1.1	**Resolution** **1. In high vacuum (SE) (1 nm (or lower) at15kV)** **2. In High Vacuum (SE) (2nm (or lower) at1kV)**
1.2	**Magnification x30-x10,00000 or more**
1.3	**Acceleration voltage 200v to 30KV in steps of 10v or lower.**
1.4	**Probe current 100na or better**
1.5	**Electron Gun Field Emission Gun, Schottky emission, Thermal type. Hybrid final lens(Combo of electrostatic & electro-magnetic lens)**
1.6	**Detectors** **• In-lens /Through lens/semi-inlens/in beam SE detector/in lensBSE** **• Evarhart-ThornlySecondary,** **• Pneumatic Retractable Back scattereddetector.** **• IR-CCD** **• In lens Energy selective backscattered detector orequivalent.**
1.7	**Specimen type Suitable even for observation and analysis of non-conductive samples** **without coating through variable pressure/low vacuum mode. Chamber pressure 50pa or more.**
1.8	**Chamber size :300m diameter or more, Provision for 12 ports or more. Chamber design should allow changing the specimens quickly.**
1.9	**Stage5axisMechanicallyeucentricmotorizedstagewithmanualcontrolpanelwithsuitable standard stubs (including multi stubs) for specimen fixing and air lock sample changing devices. (X, Y =100mm, Z=30 mm, R=360◦, T= 0˚ to 60◦) or better. Additional axis to maintain mechanical eccentricity across varying sample height orequivalent.**
1.10	**Computer Latest state of art computer with USB ports and Ethernet ports for data trans-**

	fer and net connectivity with latest Windows operating system and at least 30" ultra wide monitor with latest laser printer.512gb SSD,2TB HDD 128GB RAM or more.
1.11	**User Interface - Keyboard, Mouse, Control Panel with multifunction for the control and adjustment of frequently used SEM parameters, Manual Joystick control for stage axis.**
1.12	**Software for FESEM** **Total system control and user friendly Graphical user interface including fail safe protection and Auto functions. Latest state of art Image processing with auto image brightness & contrast, auto beam setting, auto axial alignment, autofocus, auto stigmatism, raster rotation, auto data recording, fast mode, spot mode, dynamic focus, line scan, line profile, built in image filing and image post processing functions (binary, grey measurements, grain size, grain geometry etc), pseudo color, histogram, multiple viewing screens, scan rotation, tilt compensation, dual magnification, gamma and LUT manipulation, data display, stereo** **imaging, navigation etc**
1.13	**Vacuum Fully automated pneumatic valve control with ion getter pumps, turbo molecular pump and air compressor. Chamber low vacuum of minimum of 50pa to view non conducting sample with out coating. Chamber should be in vacuum during system** **shutdown.**
2.	**Focused Ion Beam**
2.1	**Ion source and column: Suitable column with Ga liquid metal ion source with provision for beam and aperture alignment, adjustable stigmator, variable scan speed and blanker for** **blanking.**
2.2	**Resolution: ≤ 3 nm or better FIB column for imaging using statistical method.**
2.3	**Beam current: 1 pA – 100 nA**
2.4	**Source lifetime: Should be ≥1000 hours.**
2.5	**Magnification: From ≤600 X to ≥500,000X (Continuously variable)**
3	**Multi gas injection system**
3.1	**Gas Injection System (4 deposition & one etching or more) Provision for following:** **7. Platinumdeposition**

	8. Oxide deposition **III. W deposition** **iV. Carbon deposition** **V. Gas assisted etch**

3.2	**Motorized movement of Gas injection system**
B	**1. Energy Dispersive Analysis of X-Rays (EDS)** **2. WDS** **3. Electron Back Scattered Detector System(EBSD)**
1.1	**EDS system** **The EDS system should be latest, state of art system designed to be integrated with Quoted dual beam along with latest state of art computer.**
1.2	**Detector** **The EDS detector should be Liquid Nitrogen Free detector based on latest SiliconDrift Detector technology. The detector should be Silicon Drift Detector design having SDD crystal area of 70 mm2 or more to ensure high throughput at the same timeexcellent** **energy resolution. Detection from Be to U, Quantification from B to U.**
1.3	**Resolution: The following resolutions is to be guaranteed at Site. Mangenese Mn: 125 ev or better.**
1.4	**Software : EDS system software should be designed to be extremely user friendly catering to applications** **1. Elementalanalysis,** **2. multi element mapping with chemicalinformation,** **3. in built help,** **4. Customizedreporting,** **5. Automatic qualitative & qualitativeanalysis,** **6. Pt & ID – Image correlated area analysis and automaticdata collection in specified analysisarea,** **7. phase analysis, Elemental Mapping, Point Analysis & LineScanning.** **8. spectrum synthesis, etc.**
2.	**WDS:** **14. The WDS system should be integrate with the EDS system to offercombined ED+WDanalysis.**

	15. Automatic positioning of the WDS optics for accurate quantificationmeasurements. **16. WDS spectrometer should able to cover the entire range of the spectrometerfrom 100 eV to 15KeV, so that it cover the range of Be (4) to U(92), element.** **17. WDS detector must have Parallel Beam spectrometer in order to ensures maximum count rates orequivalent.** **18. The orientation of WDS should ensure the maximum countsrates.** **19. WDS must have flat crystals for better stability orequivalent.** **20. WDS should be mounted on SEM chamber, without modifying the SEM chamber in order to get maximum number of ports, for futureupgradation.** **21. The WDS detector should have a turret with 5 positions that can be equippedwith choice of the followingdiffractors:** **a. MoB4C for energies from 80-360eV, optimized for Be, B,C.** **b. 60 Å(W-Si) for, energies from about 400 eV up to 1000eV.** **c. 30 Å (OVO) for energies from 1000 eV to about 1700eV.** **d. PET for energies from. 1700 eV to3600eV.** **e. LiF220 for energies from4700-15300eV** **22. The WDS system should not have any crystals which contains Thallium, -toxic in nature.** **23. Pure element standards for at least 55 elements should be included forWDS analysis.**

3	**Electron Back Scattered Detector System (EBSD)** **System The EBSD system should work on the same computer platform as that of EDS & WDS system with user friendly graphical user interface for all functions..**
3.1	**Camera Hardware:** **4. EBSD Camera should be a CMOS-based high speed, high sensitivity, and lownoise digital camera system for EBSDapplication.** **5. Data collection rates greater than 3,000 indexed points persecond** **6. CMOS sensor**
	A. 120 x 120-pixel resolution at > 3,000 indexed points per second acquisitionspeed **B. Orientation precision less than 0.1degrees** **C. Indexing success rate 99% orhigher.** **D. Motorized slide with metal bellows vacuumprotection.** **E. Motorized insertion and retraction of the EBDScamera.** **F. Solid angle of 0.84sr in the fully insertedposition.** **G. The position accuracy of EBSD camera is to be 0.1mm orbetter.** **H. The system should have the assessment of accuracy ofIndexing.** **I. TheEBSDshouldbeoptimizedforlow–kVdataapplicationwhileworkingwithSEMS** **J. The camera should have motorized insertion and retractionmechanism.** **K. Optimized phosphor screen for high speed and high sensitivitycollection.** **L. Thecamerashouldhaveimagingdetectorstoacquireimageswithatomic,orientation, channellingcontrast.** **M. The camera should have Hexagonal or square scanning gird for minimizing grain shape artifacts, and also to provide consistent distance between neighbouring pixels which is Important for local misorientation analysis of deformedmaterials** **N. 1 no of TKDHolder**

3.3	**EBSD software should include the following features:** **(i) Data Acquisition Software (ii) Phase Reflector File Creation Software (iii) Pole Figure Software (iv) Mapping Software (v) ODF Software (vi) Imaging and Beam Control Software** **(vii) Stage Control Software (viii) Phase Identification Software.** **1)The software should have software module which can collect data with detail over large sample areas** **2)TheSoftwaremusthaveaprovisiontocheckthewhetherapointhasbeencorrectlyindexed or not , even it should able to provide whether multiple solution is aviable for thatpoint.** **3) Should have software module, which will create the queue of desired Region of Interests (ROI)forEBSDanalysisandwilldotheEBSDanalysisasperthequeuewithoutanymanual intervention** **4)Easy simultaneous EDS-EBSD collection during both EBSD pattern and scancollections.** **5)Specific Software module must be present in the EBSD software so that the Detector and collection variables must be automatically set based on analytical collection conditions for easy collection of high-qualitydata.** **a. Auto Amp Time selection for EDS detectors based on countrate** **b. Auto Phase determination for EDS mapping based on measuredelements** **c. Auto Setup Optimization for EBSD detectors based on SEM beamcurrent** **d. Smart EBSD step size recommendations based on detector andmagnification** **6. 3D EDS-EBSD module must be provided.**
	7. Different libraries/databases can be accessed and searched with EBSD software , it should search by name, by element, and filter by crystalstructure. **8. ICDD PDF4+ database must be provided apart from American Mineralogist Crystal Structure database** **The post processing software for EBSD data analysis should be supplied – minimum for 3 nos. and quote for additional license**
C	**Integrated Femtosecond laser for large volume ablation**
1	**LASER** **Femtosecond laser integrated to cross beam and should be able to corelate (region of in-**

	terest) ROI with Cross beam system.Wavelength-515nm, Max average power 10w@1 MHz, Max .pulse energy,10µJ@ 1 MHz. Pulse duration < 300 fs @ 1 MHz , Pulse to Pulse stability <2%,Scan field size 40mmx40mm. Femtosecond laser should be mounted on a AIRLOCK chamber to avoid main chamber contamination. Focus diameter <15um **Laser control unit should include power supply, Laser control module with scanner electronics and control panel and water chiller.** **Laser Milling software should store images and positions of regions of** **interest (ROI) to be milled later on by the laser. In addition, ROIs can be selected to export the stored image into the CAD editor and to navigate to or delete selected ROIs.**

D	**Nano manipulator**
1.1	**Resolution XY: < 0.5 nm or better Resolution Z: 0.05 nm or better** **Resolution R: < 6 x 10–8 rad or better Reproducibility XYZ: <2 µm or better** **Drift: <1 nm/min** **compucentric rotation field of view: ~30 µm Probing current range: 10 nA to 100 mA Maximum probing voltage: 100 V** **Probing signal resistance: 7.0 Ω** **Temperature range: 273 K to 353 K or higher** **Integrated with Dual beam laser system chamber and enables easy lamella lift out. with following functions.**
	2. **Masking function, which allow only specific axes are moved with any given command.** 3. **Macro editor, should allow defining, storing, recalling, and executingcustom motion sequences.** 4. **RoTip' and 'Gripper' control, Lift-Out & LO prep, Nanocontrol setup, Amplitude setup,** 5. **Park & restorewizard**
E	**Thermo-dynamic IN-Situ Tensile & temperature stage**
1.1	**The stage should be capable of a maximum load of at least 5,000 N or more. It should be possible at a later date to exchange load cells capable of measuring from the micro Newton range onwards.** **The stage should have a max. speed of at least 20 microns/sec.** **Standard clamps for tensile testing of metals and alloys are to beprovided Control electronics and software for control, data acquisition and online graph should beincluded."** **The load cells must be freely interchangeable by the end user and should not requirefresh calibration uponchanging.** **The stage should be provided with a 5 kN load cell. The users should be able to easily interchange load cells.** **A heating system for heating up to at least 300°C is required. This heating should be done while the tensile test is going on.**

1.2	**Controller** **The Tensile module has to be operated by a microprocessor controller Pre-selection of displacement speeds over the possible range** **The controller must automatically recognize the transducer and its calibration parameters Resolution of at least 10,000 data points over the full range of the sensor must be available**
1.3	**Optional** **Quote for 500n,1KN,2KN load cell separately** **Image capture software for capturing images from SEM with time stamp.**
	Accessories
	Essential accessories **10 KV UPS to be supplied Suitable Chiller** **Suitable Compressor**

TRAINING – Users should be imparted training at site.

Warranty – 2-years

Sr No. 26/ Reference No.27.

Detailed Description:

Vector Signal Generator Tender Specifications		
Sr. No.	**Parameters**	**Specifications**
A	**Frequency**	
1	Range	1 MHz to 30 GHz
2	Resolution of setting	0.01 Hz or better
3	Resolution of phase offset setting	0.1° or better
B	**Reference frequency**	
1	Aging	$\leq 1 \times 10^{-7}$/year or better
2	Input for external reference frequency	10 MHz
3	Output for internal reference frequency	10 MHz
4	Output level	≥9 dBm
C	**Level**	
1	Setting range	10 GHz ≤ f ≤ 30 GHz , –120 dBm to +11 dBm or higher
2	Specified level range at ~ 20 GHz fre-	+15 dBm or higher

	quency	
3	Resolution of setting	0.01 dB (nom.)
	Accuracy	5 GHz ≤ f ≤ 30 GHz , ⌖ 2 dB for > 5 dB level, ± 1.5 dB for - 40 dB < level < 5 dB
D	**Spectral purity**	
1	Harmonics	At +5 dBm, @ 2 GHz: -30 dBc @ 20 GHz: -45 dBc
2	Nonharmonics	@ 2 GHz: - 38 dBc @ 20 GHz: - 42 dBc
3	Subharmonics	@ 2 GHz: -55 dBc @ 20 GHz: -60 dBc
4	SSB phase noise carrier offset: 20 kHz	At carrier offset= 20 kHz, ≤ 1 GHz -133 dBc ≤ 2 GHz -131 dBc ≤ 3.2 GHz -127 dBc ≤ 10 GHz -120 dBc ≤ 30 GHz -110 dBc
E	**Phase coherence**	
1	Input and Output of phase coherent signal	Feature should be available
2	Connector type	SMA or SMP
F	**Analog I/Q Modulation**	
1	Channels	Separate I/Q Paths
2	Analog I/Q input	1 or more
3	Analog I/Q output	1 or more
4	Output voltage	1 V (Vp) or higher
G	**General**	
1	Power Supply	230V, 50 Hz
2	Remote programming	LAN, GPIB
3	Warranty	3 years or more
5	Form factor	Benchtop or modular PXIe-based 19" rack mountable

Sr No. 27/ Reference No.29

Detailed Description: High-pressure temperature-controlled direct shear and triaxial system

DIRECT/ RESIDUAL SHEAR:

Capable of automatically performance of direct shear tests as well as residual and incremental tests. Normal load/deformation computer control to perform constant normal stiffness

tests where the normal load is a function of a prescribed stiffness to simulate actual compressibility of a ground shear plane. Electro-hydraulic testing system with direct digital servo-control of shear load.

TRIAXIAL:

Stiff compression testing machine with automatic load or deformation control and bumpless or smooth control transfer. 2000 kN Capacity with digital control and spherical head platen. With two pressure intensifiers for the performance of advanced triaxial tests such as stress/ strain path (including Ko), Permeability, Hydraulic Fracturing and Post Failure Behaviour. Complete "turn-key" system.

150 t stiff loading frame with four column standing assembly Includes the following: 50 mm stroke length, 150 t compression and 0.8 t tension capacity, 300 mm/min max speed, 100 mm platen and 100 mm deformation sensors.

Manifold includes high pressure control solenoid and accumulator with high frequency two-stage electro-hydraulic servo valve rated to 38 l/min.

Split shear box with its top fixed and bottom mounted on sliding bearings. Includes adjustable locking mechanism to control rotation of the top box in any of the two predefined directions. High-Frequency Two-Stage Electro-hydraulic servo valve rated to 19 l/min.

Manifold including on/high pressure control solenoid and accumulator to minimize pressure ripples and sample specimen rings with for testing cylindrical cores, cubes, prisms, or fragment samples up to 150 mm size. Accepts samples with a diameter from 25 mm to 100 mm. Supplied with 12 electrical feed-through lines for in-vessel Instrumentation.

5 fluid pressure connectors: cell, pore bottom, pore top, drain and bleed ports.

Temperature control for heating triaxial cell. Internal and external thermocouples to minimize temperature gradients and control overshoot within the test chamber. Includes: Heating System Cell to +150 ºC and thermocouple with a 0 ºC to +150 ºC range. Insulation base plate and insulation blanket. Universal Signal Conditioning Modules for thermocouples.

Cell pressure/volume servo controlled Intensifier:

Computer servo-controlled pressure & volume control intensifier includes hydraulic servo valve for cell confining fluid. Pressure transducer with 0.005 MPa resolution, and volume change transducer with 0.01 cc resolution for direct measurement of pressure and volume. 10 LPM two-stage servo valve.

Other parts include:

* 70 MPa Pressure transducer with 0.25% minimum accuracy.
*** 500 cc volume transducer with 0.25% minimum accuracy.**
* Pressure panel with high pressure valves, gages and controls.
*** Pressure test gauge with (±0.25% accuracy).**
*** Fluid reservoir with pressure/vacuum/vent port for filling and draining triaxial cell.**
*** Venturi vacuum pump, vacuum gage and regulator for applying low vacuum to fill reservoir**

*** All necessary plumbing and high pressure valves for filling, pressurizing, and draining tri-axial cell.**
*** Metal cabinet mounted on casters to house the confining pressure / volume servo controlled intensifier, fluid reservoir and panel.**

<u>Microprocessor based servo controller and acquisition system:</u>

Digital servo controller, function generator, data acquisition, and digital I/O unit. Advanced servo control from any system sensor transfer switching between any connected transducer or calculated input. Can be configured to read up to 28 transducers or inputs and control up to 8 outputs.

- 850 MHz micro-processor with 64 MB RAM and 128 MB solid state disk.

- 6 kHz maximum loop rate (250 kHz conversion rate between channels).

Sample & Hold to eliminate data skew.

- 16-bit resolution. Accepts up to 24 DSB-111 Universal Signal Conditioning boards.

- Accepts up to 8 DSB-12X series boards in any combination of

DSB-121, DSB-122, DSB-123, and DSB-124 servo output boards.

- Readout for controller internal temperature, pump oil

temperature, pump oil level, & external temperature.

- 8 digital inputs and 8 digital outputs with 48-bit digital counter.

- Watchdog timer to detect control program status for automatic interlock shutdown.

- Both TCP/IP and RS-232 Communications. Power: 90-260 VAC / 50-60 Hz,.3.5 Amps

Direct Shear Test Module to perform direct shear and residual/ incremental tests. Includes shear stress or shear deformation control, normal stress, normal deformation, real-time graphical display of test progress, automatic specimen area corrections, and presentation ready graphical output. Computer control to perform constant normal stiffness tests where the normal load is a function of a prescribed stiffness to simulate actual compressibility of a ground shear plane.

Triaxial test module to automatically perform conventional triaxial static tests as well as other advanced tests such as Stress-Path and Ko-loading. Includes procedures for servo controlling the radial strain rate for post failure behaviour tests.

28 LPM, 15 HP and 21 MPa variable volume constant pressure pump. 150 litres reservoir, oil temperature indicator, pressure and return filters, pressure gage, valves, thermal and low fluid level shut off protection, heat exchanger, hydraulic hoses (10 m. long), accumulator, filler strainer, drain port and motor starter. Includes computer low/high/off remote pressure controls and oil temperature and level sensors for computer diagnostics and interlocks. Voltage: 208, 230, 380 or 460 V / 50 or 60 Hz / 3 phase.

200 t (2000 kN) compression load cell (0.12% precision) and +/-30 t (300 kN) precision universal load cell (0.05% precision). For the measurement of the top shear box normal deformation plane: 8 LVDT's for deformation sensors.

Universal Signal Conditioning Board for load cells, LVDTs, pressure sensors, thermocouples and other analogue input signals. Each module includes digital controlled offset and gain.

Servo Amplifier Board: 16-bit resolution and 325 mA maximum output servo amplifier board to drive servo valves.

Sr No. 28/ Reference No. 30

Detailed Description:Optical spectrum analyzer, OSA

Optical Spectrum Analyzer (OSA) performs highly accurate spectral measurements. Compatible with fiber-coupled and free-space light sources, these compact bench top instruments suit a wide variety of applications, such as analyzing the spectrum of a telecoms signal resolving the Fabry- Perot modes of a gain chip and identifying gas absorption lines.

REQUIRED specifications

Optical spectrum analyzer

Wavelength min 600nm

Wavelength max 1700nm

Spectral Accuracy +/- 2 ppm

Spectral Precision 1ppm

Wavelength Meter Resolution 0.1 ppm

Wavelength Meter Accuracy +/- 1 ppm

Wavelength Meter Precision 0.2 ppm

Input Power (Max) 10 mW (10 dBm)

Input Damage Threshold 20 mW (13 dBm)

Power Level Accuracy +/- 1 dB

Optical Rejection Ratio 30 dB

ALL ELECTRICAL CONNECTIONS SHOULD BE COMPATIBLE WITH INDIAN STANDARD

Optional accessories:

1. Stabilized Fiber-Coupled Light Source

Stabilized Fiber-Coupled Light Source w/ Universal Power Adapter, 360 - 2600 nm, M6

Taps. Included compatible fiber patch cable (Low OH) covering the entire wavelength range (preferably with FC/APC at end 1 and source compatible connector at end 2).

Fiber coupled power at least 10 mW. At Least 2m in length.

Wavelength Range 360- 2600 nm

Peak wavelength 1000 nm

Bulb electrical power 9WOutput coupling Fiber coupled (SMA) and Free space

Coupled Optical Power 10mW

Output Power Stability < 0.05%

Output Power drift per hour 0.01%

Output Power drift per ° C 0.1%

Color Temperature 2796 K

Color temperature Stability +/- 15 K

Included Power Supply 12 V, 100 - 240 VAC

1) Compatible (with light source) fiber patch cable (Low OH) covering the entire wavelength range (End 1: SMA, End 2: FC/APC). Core Ø400 µm, 0.39 NA. At Least 2m in length. (quantity = 1)

2) Compatible (with OSA input) fiber patch cable (Low OH) covering the entire wavelength range (End 1: FC/PC, End 2: FC/APC). Cores up to Ø50 µm and NA up to 0.22. At Least 2m in length. (quantity = 1)

3) Compatible (with OSA input) fiber patch cable (630 HP) covering the entire wavelength range (End 1: FC/PC, End 2: FC/APC). Tubing: FT900Y. At-least 2m in length. (quantity = 1)

4) SMA to SMA meeting sleeve (quantity = 1)

2. Variable Optical attenuator with the following specifications:

Operating wavelength 630 nm

Wavelength range 620 to 650 nm

Attenuation range 3.0 to 50 dB

Attenuation resolution 0.15dB

Transmission range 0.001 - 50.1 %

Insertion loss <= 3.0 dB

Return loss >= 40 dB

Max power 300 mW

Operating temperature 0 to 70 deg

Storage Temperature - 40 to 80 deg

1 meter Fiber Pigtail on each side, FC/APC connector3. Isolator with fiber the following specifications:

Polarization Independent

Fiber Type FC/APC

Center Wavelength 635nm

Operating Range 625 to 645 nm

Max Power 0.5 W (CW)

Isolation 25 dB (min), 30 dB (Typ.)

Insertion Loss (without Connectors) 1.4 dB (Typ.), 1.6 dB(Max)

Polarization Dependent Loss <= 0.25dB

Return loss >= 50 dB

Fiber connector FC/APC

4. Polarimeter with the following specifications:

Wavelength Range 600 nm - 1080 nm

Dynamic Range -60 dBm to +10 dBm

(10-6 mW to 10 mW)

Sampling rate - default 30 Samples/s

Sampling rate - maximum 400 Samples/s

Measurable SOP Entire Poincaré Sphere

Azimuth accuracy ±0.25°

Ellipticity accuracy ±0.25°

DOP Accuracy ±1.0%Free Space Aperture Ø3 mm

Input Fiber Connector FC/APC

Maximum Input Beam Divergence 2 0

Warm-Up Time for Rated Accuracy 15 min

Note:

1. Accepts Free-Space or Fiber-Coupled Input; Rotating-Wave-Plate-Based Measurement

2. SOP: States of Polarization; For any SOP with -30° < Ellipticity < 30°; DOP: Degree of Polarization

3. All technical specifications to be valid at 23 ± 5 °C and 45 ± 15% non-condensing relative humidity

Additional Specifications:

1. Command and Control Interface - USB 2.0 Mini-B

2. Input Power Supply - Via USB 2.0 Mini-B Interface or DS15 External Power Supply

3. DS15 Power Supply Ratings - 15.0 V; 1.2 A

4. Operating Temperature Range - 5 °C to 40 °C

5. Storage Temperature Range - -40 °C to 70 °C

6. Bottom Mounting Features - Metric

7. All polarization specifications to be valid for optical powers from -40 dBm to +3 dBm (0.0001 mW to 1.995 mW).

Sr No. 29/ Reference No. 31

Detailed Description: Rotary evaporator with diaphragm high-vacuum pumps and vacuum controls and chillers system.

Touch display for controlling the entire system including the vacuum and Motorized Lift for Smooth up and down movement

Indication of active function : LED Rings

Head angle can be adjusted up to 45 degrees

On power, failure complete assembly must automatically move up

Digital display of RPM, Temp and vacuum

RPM Range : 10 to 280 RPM

Digital Water bath Having LCD Display for Set and Actual Valve

Temp Range : 20 to 210 °C

Universal heating bath for oil & water

Clamping sleeve for easy removal of vapor tube

Temp Accuracy : ±1°C solvent library

Overheat protection bath – cut Off at 5°C over set temp

Integrated vacuum controller

The universal heating bath accommodates 50 ml to 5000 ml evaporating flask with single joint size

Heating Bath Capacity Up to 4.5L or Above

CE Certification

Warranty : 3-Years

1. **Two additional vacuum pumps and 2 communication cables to connect vaccum pump with vaccum controls**

- **Two stage Diaphragm Vacuum pump**
- **All internal Parts of pump must be Made of PTFE Or PTFE Compound to make it Chemical Resistant in Nature**
- **Ultimate Achievable Vacuum : 7mbar**
- **Suction Capacity : 2.0 m3/Hr**
- **Power input: 180W**
- **CE Certification**

- **Warranty : 3 Years**
- **Customer Kits for maintenance**

Sr No. 30/ Reference No. 32

Detailed Description:NGS System

The system should be able to do Next Generation Sequencing. This is very much desirable if the system has an in-built scanner that can able to scan microarray slides.

2. This should be a single instrument that performs clonal amplification, sequencing by synthesis sequencing, paired-end run and primary data analysis.

3. System should offer flexible scalability from 20–120 Gb (130-400 million cluster) in a single run to support a broad range of applications, including metagenomic sequencing, de-novo sequencing and re-sequencing of microbes, complete de-novo sequencing and re-sequencing of higher eukaryotes including human and plant genomes, ChIP sequencing, transcriptome sequencing (microbial, plants and human), etc.

4. The system should also include an option to integrate with a cloud based genomic computing environment which is an easy, secure and cost-effective way to store, analyze, and share genomic data.

5. The sequencing technology should offer accurate sequencing of homopolymers (up to 20 bases) and highest read quality score of Q30 for more than 75% of the base calls having >99% accuracy ensuring quality control steps.

6. Library preparation should be easy and completed within 12 hrs with minimal hands on time. Ease of library preparation and time required will be one of the important criteria for selection.

7. System should be able to sequence multiple samples at a time with option of using barcodes for sample multiplexing (up to 384).

8. The system should include latest software, hardware, accessories and technology available at the time of installation which is needed for generating high quality sequence reads.

9. The vendor should offer at least 3 yrs of AMC and 7 yrs post purchase service and parts support.

10. The vendor should also offer kits and reagents for library preparation from DNA/RNA.

Sr No. 31/ Reference No. 33 (Revised)

Detailed Description: Highly sensitive potentiostat / galvanostat

Sr No.	Description	Numerical Value

1	Compliance voltage	± 12 V or better at ± 400 mA
2	Maximum Output Current	± 400 mA or better at ± 15 V
3	Output Voltage Range	± 10 V
4	Current Ranges	± 100nA to ± 0.1A in seven ranges
5	Measured current resolution	5 pA on 100nA full scale range
6	Measured current accuracy	± 0.2% of setting; ±0.05% of range
7	Maximum scan rate	50 V/s with 10 mV steps or better
8	Minimum scan rate	10 μ V/s
9	Leakage current	< 15 pA at 25 °C
10	Interface	USB interface for connection with PC
11	Input bias current	< 10pA
12	Input Impedance of electrometer	>1GΩ parallel with 10 pF
13	Available experimental techniques	Cyclic Voltammetry (CV), Linear Sweep Voltammetry (LSV),Chronoamperometry (CA), Chrono-coulometry, Chronopotentiometry, Constant Potential Electrolysis (BE), Constant current Electrolysis (BE), Differential Pulse Voltammetry (DPV), Square-Wave Voltammetry (SWV), Chronopotentiometry (CP).
14	Software for system control and data acquisition should be supplied with the system. The current set up should be upgradablefor Bi-Potentiostat for RRDE/RDE measurements and Electrochemical Impedance Spectroscopy: Frequency range (100 μHz to 1MHz or better).	
15	Electrochemistry Cell: It should consist of the following: Glass cell (volume ≤ 20 mL) 2 no.,	

	3 mm or smaller diameter glassy carbon working electrode 1no., Pt wire Counter electrode 1 mm or smaller diameter 1 no., Ag/AgCl reference electrode (Aqueous) & Ag/AgCl reference electrode (Non-Aqueous) 1 no. each Suitable Lid for the cell 2 no. Suitable and purge tube 2 no. The full cell should be air tight with all the inserted accessories.
14	Electrochemical Software and general accessories: Software should be compatible with Windows 8 or higher version and have facility to record additional signal viz EQCM, bi-potentiostat etc. Import/export ASCII. Ready-to-use Vis & Generic interface for .Net applications should be included. It should have facility to display up to 4 plots simultaneously. The software should support all the electrochemical measurement techniques mentioned in Point 13.The system should include power supply 220V/50Hz, Interface Cable for Serial & USB Port, Cell Cable, and Manuals & Installation kit.
15	Warranty: Instrument should be under warranty for a period of 3 years from the date of installation.

Sr No. 32/ Reference No. 34 (1000016424)

Detailed Description: Glyconeer 2.1- Automated Oligosaccharide Synthesizer

Technical Specifications Automated Oligosaccharide Synthesizer

• Speed and Accuracy – delivery of solvents and reagents via Argon pressure

• Versatility – compatible with a wide range of chemistries and various solvent/reagents combinations

• Easy to use – software designed to maximize simplicity while maintaining functionality

• Temperature control of reaction vessel from -40 to +80 °C

• On-line UV detection to monitor coupling efficiency

• Synthesis scale from 10-100 micromoles

• 64-position carousel for the delivery of monosaccharide building blocks from vials

• Triple-jacketed glass reaction vessel

• Separate Fraction and Waste collection

Sensors

Fmoc quantification (UV sensor)

Pressure sensor for each unit

Fluidic sensor

Liquid level sensor for waste bottle

Temperature sensor (for cooling of activating reagents)

Bottles for Reagents (All reagents should be in pressurized bottles)

6 x deprotecting reagents

8 x solvents

6 x activating reagents (2x cooled 8 … 10 °C)

4 x miscellaneous reagents (e.g. reagents containing water)

64 x building block vials with septum not pressurized (just for delivery the vials get pressurized)

Fraction collector

26 tubes for the fraction collector for collecting contents after the reaction for offline monitoring or recovery

Waste 1 Waste bottle 5 L

Electrical supply Voltage: 230 V, 50 Hz,Current: 3 A

Inert Gas supply Argon or Nitrogen, 4… 8 bar (60… 120 PSI)

Interfaces 2 x USB, 2 x Ethernet, 1 x RS 232 (for cryostat) Argon and cryostat connectors

Used connections 1 x Ethernet to laptop, 1 x RS232 to cryostat

Control Computer Windows 10 including control software with preprogrammed cycles

Cooling System

Cryostat: with controller, limited to -75 °C to +100 °C and within the application to -40°C to +70°C and should include 10 L of high performance thermofluid

Warranty

Standard 1 Year Warranty along with instrument & Extended warranty for additional 1 year.

Sr No. 33/ Reference No. 35

Detailed Description: High voltage nanosecond pulse electric field generator

Specifications of high voltage nanosecond pulse generator

1. Output pulse amplitude: 10 kV max

2. Output pulse shape: rectangular like

3. Output pulse polarity: Positive

4. Output impedance: 50 ohm

5. Output pulse width: 10 ns (fixed, FWHM)

6. Rise/fall time of output pulse: 2-3 ns (max)

7. Repetition rate: min. 1 kHz (internal and external triggering)

The following accessories must be required:

1. Power supply cable of the pulse generator

2. User manual/brochure

3. High voltage connector/cable along with voltage divider for measuring and capturing the high voltage pulse on the oscilloscope.

Sr No. 34/ Reference No. 36

Detailed Description: sCMOS Sensor based Monochrome camera

Camera specifications:

1. Pixel size: 6.5 um(H)*6.5 um (V)

2. Pixel: at least 2000 (H)*2000 (V)

3. Type: Monochrome

4. Frame rate: at least 30 FPS @ full resolution

5. Quantum efficiency: up to 82% at peak

6. Spectral range: 370-1000 nm

7. Readout noise: Not more than 2 rms e-

8. Dark current: Not more than 0.8 e/pixel/s

9. Full well capacity: 30000 e-

10. Dynamic range: at least 30000:1

11. Binning: 1X1, 2X2, 4X4

12. 16 Bit A/D

13. Operating temperature: 10-40 degree C

14. Optical mount: C-mount

A. The camera should come with a software and required drivers.

B. User manual and all relevant documentations should be provided in English.

C. The camera should come with all necessary cables and accessories for working of the camera.

Sr No. 35/ Reference No. 37

Detailed Description: Non-Contact Metrology System

This tender includes the purchase of a 'non-contact metrology system,' that will be used for characterizing 2D and 3D surfaces. The desired specifications of each of the components are given below.

Notes and essential terms for qualification:

1. The vendor should provide details of at least five customers from India (at least three from IITs or other government research facilities in the past three years) where a similar system/ equipment from the manufacturer has been working successfully. Wherever the system is being used, background checks may be done at the expense of the vendor.

2. The price quote must include the price of the software, accessories, packing, shipping, taxes, and duties, etc. Educational/research/academic discounts may be applied, if applicable. An authorization letter should be furnished along with the quotation.

3. A compliance statement should be enclosed with the quotation. Point by point list of the product specifications against what is asked must be provided in the compliance statement to demonstrate that the requirements have been met.

4.Kindly quote every setup and accessories as per the IIT Bombay's tender specification format with all the supportive brochures, documents, and literature. In case of incorrect format or insufficient attachment, no clarification will be asked and could be subject to a direct rejection of the bid.

5. As and when the queries are raised against any technical point, it must be addressed promptly, positively within *seven working days*. In case the response is not received within seven working days, the offer will be rejected on technical grounds.

Technical Specifications:

S N.	SPECIFICATIONS/ PART/ACCESSORIES	DESCRIPTION & DETAILS
1.	Mode of scanning	Non-contact type
2.	Method	White light Interferometry/Coherence Scanning Interferometry (CSI)/Phase Shifting Interferometry (PSI)
3.	Measurement parameters	2D and 3D surface profile: Opaque Film thickness, step height, surface roughness, surface texture
4.	Sample type	Films, coatings, opaque, transparent, rough and reflective material Note: Performance must be demonstrable on samples provided by IIT Bombay to all the shortlisted bidders and the final technical qualification will be decided after the demonstration and evaluations of results. Samples may be solid, semisolid or liquid.
5	Sample reflectivity	0.05%-100%
6.	Camera	High resolution (>1.3 MP)
7.	Tip/Tilt	Motorized and manual tip/tilt of +/- 3 degrees
8.	Auto-part Finding and Auto focussing	Yes
9.	Crash safety feature, i.e. auto crash detection and prevention	Yes
10.	Step Height (range, repeatability, and accuracy)	1. Able to measure minimum step of 5 nm or less 2. Able to measure maximum step of 30 mm or more 3. Step height repeatability (1-sigma) of 0.1% or better for a step height standard of 1.8 microns or larger (National metrological institute traceable)

		4. **Stepheight accuracy (1-sigma) of 0.3% or better for a step height standard of 1.8 microns** ***OR*** **Step height accuracy (1-sigma) of 0.8% or better for a step height standard of 8 microns** **(National metrological institute traceable)**

11.	**Z stage (travel length and resolution)**	**1. 100 mm or more travel automated /motorized with 100 nm or better resolution, and** **2. 100 micron or more travel with a piezo stage,** **3. 0.01 nm or better vertical resolution for the entire Z scan range independent of optical accessories or surface**
12.	**RMS repetability**	**0.01 nm or better, independent of optical accessories, data acquisition range, and surface** **(sub-angstrom repeatability is needed to accurately measure surface roughness of Si wafers, for example, that have Ra of a few angstrom)**
13.	**XY Stages (range and resolution)**	**1. Motorized and programmable** **2. Minimum 150 mm travel in each direction** **3. Lateral optical resolution of 0.5 micron or better** **4. Spatial sampling of 0.1 micron or better using zoom from complusary items**
14.	**Objectives type**	**Michelson/Mirau**
15.	**Objectives turrets**	**1. Objectives must be turret mountable** **2. 4 or more objective turrents that are motorized and automated**
16.	**Objective**	**5x-6x and 50x (total two objectives)**
17.	**Motorized Software Selectable Optical Zoom Lens:**	**(0.5x or 0.55X), 1x and 2x**
18.	**Vibration isolation table:**	**Standard Vibration isolation table or unit and worktable. In absence of vibration isolation table, the performance of machine must not be affected by any induced and natural vibration**

19.	**Illumination source:**	**White light LED source and green light source**	
20.	**Software:**	**1. Compatible software for Data Acquisition and Analysis in a single platform and package with the following capabilities:** **Autofocus and Auto-alignment, Automated and user-friendly operations, Step height measurement, Surface roughness measurement, Surface Texture measurement, Optical Stitching capability, Offline processing capability.** **2. No 3rd party software other than MS Office and OS** **3. Software Licence Validity: Minimum 19 years and above with free updates when released** **4. Minimum 5 additional software for analysis**	
21.	**Software functions**	**•Anchor Statistics Analysis** **•Auto-covariance Analysis** **• Bearing Ratio Analysis** **• Confinement Analysis** **• Cross Hatch Analysis** **•Digital High/Low Pass Analysis** **•Feature Statistics Analysis** **•Filtered Histogram Analysis** **• Histogram Step Measurement** **• Intensity Plot** **• Power Spectral Density (PSD) Analysis**	**• Rz Surface Analysis** **•Scrolling Contour Analysis** **• Slope Analysis** **• S-Parameters Analyses** **• Standard Plots** **• Step Measurement Analysis** **• Surface Area Analysis** **• Stylus X/Y Analyses** **• Surface Area** **• Texture Analysis** **• Trace Analysis**

			• Volume Analysis **• Multiple Region Analysis**

22.	**Computer:**	**Branded and updated PC with Windows 10 operating system, i7 processor, 16 GB RAM, 1 TB hard drive, Flat panel 19 inch LCD monitor and DVD writer**
23.	**Documentation (Manual, Drawings, if any, and Literature):**	**Complete set of documentation in hard copy as well as softcopy**
24.	**Installation and Commissioning:**	**1. The lead time for the delivery of the equipment should not be more than three months from the date of receipt of the purchase order.** **2. The instrument to be installed, tested, and commissioned by the manufacturer's qualified engineer/representative at IIT Bombay and performance must be tested on NIST certified standards.** **3. Trained service engineers in India (preferably in Mumbai) should be available to resolve any technical problems in the future.**
25.	**Warranty:**	**Twenty-four months of warranty after successful installation/commissioning and acceptance. Including replacement of parts.**
26.	**Annual maintenance cost**	**For the next three years after warranty (must be quoted year-wise manner)**
27.	**Spares availability Assurance:**	**The vendor must confirm the availability for at least ten years of the spare support of the offered system**
28.	**Standards: NIST Certified Standards**	**Should be compatible with the system to be supplied**
29.	**1.Step Height standard** **2.Surface Roughness standard**	**To be quoted as an option** **To be quoted as an option**
30.	**Optional Objectives**	**Quote all other objectives that can be fitted with the machine**

31.	**Optional accessories**	**Quote all the accessories of the quoted system separately**
32.	**Training and installation**	**Installation: YES** **Minimum of three days on site training. Training to operate the instrument must be given to our research scholars free of charge.**
33	**Optional extended warranty of an additional12 months**	**Quote it in option after the expiry date of one year warranty**
34.	**19 Inch retina display**	**Quote as an option**

Sr No. 36/ Reference No. 38

Detail Description : an optical 3D coordinate measurement machine (CMM) that will be used for characterizing the form of 2D and 3D surfaces. The desired specifications of each of the components are given below.

Notes and essential terms for qualification:

1. The vendor should provide details of at least five customers from India (at least three from IITs or other government research facilities in the past three years) where a similar system/ equipment from the manufacturer has been working successfully. Wherever the system is being used, background checks may be done at the expense of the vendor.

2. The price quote must include the price of the software, required accessories, packing, shipping, taxes, and duties, etc. Educational/research/academic discounts may be applied, if applicable. An authorization letter should be furnished along with the quotation.

3. A compliance statement should be enclosed with the quotation. Point by point list of the product specifications against what is asked must be provided in the compliance statement to demonstrate that the requirements have been met.

4. Kindly quote every setup and accessories as per the IIT Bombay's tender specification format with all the supportive brochures, documents, and literature. In case of incorrect format or insufficient attachment, no clarification will be asked and could be subject to a direct rejection of the bid.

5. As and when the queries are raised against any technical point, it must be addressed promptly, positively within seven working days. In case the response is not received within seven working days, the offer will be rejected on technical grounds.

Technical Specifications:

1. Mode and method of scanning: Non-contact, optical using focus variation

2. Measurement parameters:

a) 2D and 3D form and surface profiles, surface texture, surface roughness

b) Measurement data must also include true color information

3. Sample type:

a) Both rough and highly reflective material

b) Performance must be demonstrable on samples provided by IIT Bombay to all the short-listed bidders, and the final technical qualification will be decided after the demonstration and evaluations of results.

4. Vertical Measurement (Z axis):

a) Travel range of 300 mm or more, motorized

b) Minimum measurable height of 10 nm or less

c) Maximum measurable height of 60 mm or more

d) Resolution of 10 nm or better

e) Maximum scanning speed of 3 mm/s or more

f) Maximum sample height of 300 mm or more

5. Lateral Measurements (X-Y axes):

a) Travel range of 300 mm or more in each direction, motorized

b) Maximum field of view of 5 mm or more in each direction

c) Lateral resolution of 1 micron or better

d) Travel speed of 50 mm/s or more

e) Maximum sample weight of 20 Kg or more

6. Maximum measurable slope angle 90 deg or more

7. Surface roughness Minimum measurable roughness Ra of 50 nm or less, and Sa of 25 nm or less

8.Rotation unit:

a) 2-axis motorized rotation unit must be included to allow scanning of samples in different orientations

b) Axis 1 (rotation) must allow full 360 deg rotation

c) Axis 2 (tilt) must allow tilt of -15 deg to 90 deg or more

d) The clamping unit should be provided to hold part sizes ranging from 2 mm to 50 mm

9. Objectives:

a) All the objectives that allow measurement range and resolution specified in this table must be provided

b) Automatic change of objectives must be possible

10. Lighting:

a) Electronically controllable, high-power, LED, color, co-axial illumination

b) Electronically controllable LED ring light

11. Working environment

a) System monitoring and logging of temperatures and vibrations

b) Insensitive to vibrations

c) Insensitive to ambient lighting

d) Insensitive to temperature changes. The permissible deviation limit of less than 1K per hour.

e) Can maintain the required accuracy in ambient temperatures ranging from 20 deg – 28 deg

f) Noise-free operation

12. Operating voltage 100-240 VAC, 50-60 Hz

13. Vibration isolation table: Standard Vibration isolation table or unit and worktable. In the absence of a vibration isolation table, the performance of the machine must not be affected by any induced and natural vibration

14. Software:

a) Compatible software for data acquisition and analysis in a single platform and package with the following capabilities:

Autofocus and auto-alignment, automated and user-friendly operations, profile form measurement, volume measurement, step height measurement, surface roughness measurement, surface texture measurement, 2D imaging, edge and contour measurement and analysis, automatic optical stitching capability, comparison with CAD data, export of measurement data in standard file formats, offline processing capability.

b) No 3rd party software other than MS Office and OS

c) Software Licence Validity: Minimum 19 years and above with free updates when released

d) Minimum 5 additional software for analysis

15. Computer: Branded and updated PC with Windows 10 operating system, i7 processor, 32 GB RAM, 2 TB hard drive, two flat-panel 27-inch monitors, DVD writer, keyboard, mouse, joystick.

16. Documentation (Manual, Drawings, if any, and Literature): Complete set of documentation in hard copy as well as softcopy

17. Installation and Commissioning:

a) The lead time for the delivery of the equipment should not be more than three months from the date of receipt of the purchase order.

b) The instrument to be installed, tested, and commissioned by the manufacturer's qualified engineer/representative at IIT Bombay and performance must be tested on NIST certified standards.

c) Trained service engineers in India (preferably in Mumbai) should be available to resolve any technical problems in the future.

18. Warranty: Twenty-four months of warranty after successful installation/commissioning and acceptance. Including replacement of parts.

19. Annual maintenance cost For the next three years after warranty (must be quoted year-wise manner)

20. Spares Availability Assurance: The vendor must confirm the availability for at least ten years of the spare support of the offered system.

21. Standards: NIST Certified Standards Certified standards for form, roughness, step height calibration must be supplied

22.Optional Objectives Quote all other objectives that can be fitted with the machine

23. Optional accessories Quote all the accessories of the quoted system separately

24.Training and installation:

a) Installation: Required.

b) Minimum of three days of on-site training. Training to operate the instrument must be given to our research scholars free of charge.

25. Optional extended warranty of an additional 12 months Quote it in option

Sr No. 37/ Reference No. 39

Detailed Description:

Technical Specifications

1. Mode and method of scanning: Contact-type using stylus or tracer

2. Measurement parameters:

(a) 2D and 3D form and surface profiles, surface texture, surface contours, and roughness

(b) Measurements must be run in a fully automatic manner

3. Sample type: Performance must be demonstrable on samples provided by IIT Bombay to all the shortlisted bidders, and the final technical qualification will be decided after the demonstration and evaluations of results.

4. Measurement range, resolution, and accuracy:

(a) Z-axis: travel range of 24 mm or more, motorized, resolution of 1 nm or better

(b) X-axis: travel range of 12 mm or more, motorized, resolution of 5 nm or better, speed of 200 mm/sec or faster

(c) Vertical column with travel range 500 mm or more, motorized, resolution of 50 nm or better

(d) Additional Y-axis table of minimum 200 mm x 200 mm dimension to allow fully-automated 3D contour measurements

(e) Y-axis: travel range of 200 mm or more, motorized, resolution of 50 nm or better, the loading capacity of 20 kg or more, speed of 200 mm/sec or faster

(f) Drive speed: 40 mm/sec or faster in each direction

(g) Drive straightness: 0.25 microns or better over 100 mm, and 0.5 microns or better over 200 mm in each direction

(h) Probe unit accuracy of +-(0.3 + |0.02H|) microns or better

(i) Accuracy between two measured points +-(2 + 0.02L) microns or better

(j) The drive unit must allow automatic inclination from -45 deg to + 10 deg to enable precise alignment of the drive unit with the test component

5. Stylus/tracers:

(a) (Qty. 2 nos.) standard length stylus, R 5 micron, 40 deg, diamond tip

(b) (Qty. 1 nos.) long-range stylus, R 5 micron, 40 deg, 25 mm depth, diamond tip

(c) (Qty. 1 nos.) long-range stylus, R 2 micron, 60 deg, 25 mm depth, diamond tip

(d) (Qty. 2 nos.) standard length ball stylus, R 250 micron, sapphire tip

(e) (Qty. 1 nos.) long-range ball stylus, R 250 micron, depth 25 mm, sapphire tip

6. Working environment:

(a) System monitoring and logging of temperatures and vibrations

(b) Insensitive to vibrations

(c) Insensitive to ambient lighting

(d) Insensitive to temperature changes.

(e) Can maintain the required accuracy in ambient temperatures ranging from 20 deg – 28 de

(f) Noise-free operation

(g) Protective enclosure

7. Operating voltage: 100-240 VAC, 50-60 Hz

8. Vibration isolation table: Standard active vibration isolation table or unit and worktable. The performance of the machine must not be affected by any induced and natural vibration

9. Software: Compatible software for data acquisition and analysis in a single platform and package with the following capabilities:

(a)Automated and user-friendly operations, profile form measurement, volume measurement, step height measurement, surface roughness measurement, surface texture measurement, edge and contour measurement and analysis, micro-contour analysis, advanced 3D analysis using Y-table, export of measurement data in standard file formats, offline processing capability.

(b) No 3rd party software other than MS Office and OS

(c) Software License Validity: Minimum 19 years and above with free updates when released

(d) Minimum 5 additional software for analysis

10.Computer: Branded and updated PC with Windows 10 operating system, i7 processor, 32 GB RAM, 2 TB hard drive, two flat-panel 27-inch monitors, DVD writer, keyboard, mouse, joystick.

11.Documentation (Manual, Drawings, if any, and Literature): Complete set of documentation in hard copy as well as softcopy

12.Installation and Commissioning:

(a) The lead time for the delivery of the equipment should not be more than three months from the date of receipt of the purchase order.

(b) The instrument to be installed, tested, and commissioned by the manufacturer's qualified engineer/representative at IIT Bombay and performance must be tested on NIST certified standards.

(c) Trained service engineers in India (preferably in Mumbai) should be available to resolve any technical problems in the future.

13. Warranty: Twenty-four months of warranty after successful installation/commissioning and acceptance. Including replacement of parts.

14. Annual maintenance cost: For the next three years after warranty (must be quoted year-wise manner)

15. Spares Availability Assurance: The vendor must confirm the availability for at least ten years of the spare support of the offered system.

16 Standards: NIST Certified Standards Certified standards for form, roughness, step height calibration must be supplied

17. Required accessories:

(a) XY leveling table with digital heads

(b) Stand/trolly for the computer

(c) UPS

18. Training and installation

(a) Installation: Required.

(b) Minimum of three days of on-site training. Training to operate the instrument must be given to our research scholars free of charge.

Sr No. 38/ Reference No. 40

Detailed Description: FactSage thermodynamic software

- **The thermodynamic software must include an oxide database for slag, refractory, mold flux and special flux (oxy-fluoride). This must include systems such as oxide system containing CaO-MgO-Al2O3-SiO2-FeO-Fe2O3-MnO-Mn2O3-TiO2-Ti2O3-CrO-Cr2O3-Cu2O-NiO-ZnO-P2O5, sulphide system CaS, MgS, FeS, and MnS, oxyfluoride containing Na2O-K2O-CaO-MgO-Al2O3-SiO2-B2O3-BaO-SrO-NaF, CaF2 with minor sulphides and oxides contents mentioned earlier**

- **The thermodynamic software must have a viscosity database containing structural viscosity model for oxide melt covering Na2O-K2O-CaO-MgO-Al2O3-SiO2-FeO-Fe2O3-MnO-TiO2-Ti2O3-CrO-Cr2O3-NiO-B2O3 and Fluorides**

- **The thermodynamic software must provide developer access that can allow to build on existing database, create additional database and automate equilibrium and property calculations**

Sr No. 39/ Reference No. 41 (1000016649)

Detailed Description: Glow Discharge Optical Emission Spectroscope

1. Description of the ITEM:

Glow Discharge Optical Emission Spectrometer for Elemental analysis with Depth Profiling of materials with built in interferometer or any other direct measurement

2. Detailed SPECIFICATIONS:

High resolution pulsed radio-frequency Glow Discharge Optical Emission Spectrometer (GD-OES) consisting of Polychromator and Monochromator for Elemental analysis and Depth Profiling of both thin and thick films as well as bulk materials, conductive and non-conductive (including polymers and ceramic) samples with the following detailed specifications.

I. Optical Spectrometer:

(A) Polychromator:

1. The optics of the spectrometer should be equipped with 47 analytical channels for the analysis of Al, Ag, As, Au, B, Ba, C, Ca, Cd, Ce, Cl, Co, Cr, Cu, F, Fe, H, Hf, In, K, La, Li, Mg, Mo, ,Mn, N, Na, Nb, Ni, O, P, Pb, Pr, Pt, S, Sb, Sn, Si, Sr, Ta, Te, Ti, V, W, Y, Zn, Zr and the number channels to be extendable for a maximum of 47+1 with monochromator option. The additional element is user selective.

2. Polyscan controlled primary slit movement for automatic scanning around all mounted channels should be provided.

3. A Paschen-Runge Mount with a focal length of 0.5 meter or better should be used.

4. A high performance holographic, ion-etched blazed diffraction grating with 2400 gr/mm or better should be used.

5. The gratings should cover the spectral range at least 110 – 620 nm

6. The optics of the grating used should be that of MgF2.

7. Linear dispersion should be 0.27 nm/mm - 3rd order; 0.41 nm/mm - 2nd order; 0.83 nm/mm - 1st order or better.

8. The optical system must be cleaned through purging with neutral gas and not merely evacuated.

9. Provision for nitrogen purge should be given so that analysis in the deep UV region is possible (inlet, outlet and recirculation pump should be provided)

10. Optical mask with more than 200 pre-etched secondary slits should be provided.

11. All channels should be equipped with high-dynamic range detectors (HDD) for real-time optimized sensitivity (dynamic range: 5 x 109 or better)

12. Optical Interface for collection and transition of the emitted light from the GD source directly to the spectrometers should be without optical fibers.

13. Optical lines needed to control the physical parameters of the discharge should be included in the offer and not considered as analytical lines.

14. Flat field polychromator should be provided for the analysis of Li, K and F with extended wavelength range up to 850 nm. It should be provided with blazed holographic grating with 1200 gr/mm or better.

(B) Monochromator:

1. Monochromator should be provided for full-wavelength range scanning and should allow simultaneous measurement of any "n+1" element within a depth-profile analysis and any sequence of elements in a bulk program.

2. Czerny-Turner optical mount should be provided

3. High performance holographic, ion-etched blazed diffraction grating with 2400 gr/mm or better should be provided

4. Focal length should be 640 mm or better

5. Controlled direct drive scanning mechanism should be provided.

6. It should include the full spectrum record, identification of elements and should be built in with data base of optical lines.

II. RF Excitation Source:

1. A pulsable radio frequency source should be provided with a frequency of 13.56 MHz and automatic matching in pulsed and non-pulsed mode and should be capable of analyzing both conductive and non-conductive samples without any change.

2. Spacious sample chamber should be provided for the analysis of large samples (should be able to analyze samples of minimum 10 x 10 mm and maximum of 40 cm diameter).

3. An automatic matching network with incidental and reflected power continuously monitored and corrected should be provided.

4. The source should be capable of fast sputtering of thick organic layers with the built in UFS system.

5. The depth resolution should be better than 1 nm.

6. The excitation source should have a protection system against leakage of the high frequency radiation for operator safety.

III. Glow Discharge Lamp:

The glow discharge lamp should have an anode and cathode with argon and vacuum circuits to measure vacuum.

1. The main anode diameter shall be approximately of 4 mm.

2. A pumping system with suitable two rotary vacuum pumps should be provided to get a vacuum of 10-3 torr or better in the lamp region for obtaining optimum crater shape.

3. The source should allow to prepare samples for SEM observation

4. The pressure of the gas should be kept constant in the lamp and should be monitored with suitable gages and controlled through software.

5. The parameters for the lamp should be controlled automatically.

6. Easy and simple sample loading with an automatic display of the sample status should be provided.

7. Electro-pneumatic pressure control valves, solenoid controls and safety circuits should be provided, wherever required.

IV. Depth Profiling

1. The GD-OES system should include a built-in interferometer or any direct measurement system for real time sputtering depth measurements. The depth resolution should be 1 nm or better

2. The instrument should be capable of performing both bulk (quantitative elemental) and quantitative depth profile analysis. The collected data should provide the composition in atomic and weight percents. Suitable library should be provided for regular calibration of the machine.

V. Data Acquisition and Processing System:

1. Ultra fast data acquisition module for both elemental and depth profiling analysis should be provided with a dynamic range of 10E9 mandatory for depth profile of ultra thin layers.

2. Data acquisition system should be of latest configuration and should be equipped with data transfer ports.

3. Software for bulk elemental analysis and depth profile within the same module should be provided.

4. The software should be capable of acquiring data, processing and displaying the results of elemental and surface analysis with the following salient features.

a. Various operating modes (Real Power, Constant Vdc etc.)

b. Calibration with bulk and possibly layered materials

c. Automatic background correction

d. Table of line interferences

e. Storage of raw data and automatic re-calculation for quantitative and depth analysis

f. High speed data acquisition

g. Multiple (staged) acquisition for analysis of multiple layers with varying thickness

h. Display of acquisition profile in real-time

i. Built in Data Base of sputtering rates

j. Quantitative surface analysis including IQ for depth profile analysis

k. Calculation of Coating Weight/Thickness

l. Special layer mode for easy calibration without Certified Reference Materials

m. Automatic data transmission into standard or customized reporting formats

n. Automatic storage of all results with raw data for further processing

5. Suitable laser jet based color recorder, toner cartridge and suitable USB interface cable should be provided.

6. All the software employed need to be duly licensed

VI. Electrical Requirements:

1. The instrument should be operable with 230 ± 10 V, Single Phase, 50 Hz.

2. Power regulation to compensate for fluctuations of in-line power supply up to ~ ± 10% should be provided.

VII. Optional Accessories: (quote separately)

The following essential accessories should be supplied along with the instrument

1. Complete kit for 2 mm anode (anode, ceramic insulation for anode, 1 red o-ring for ceramic, 1 black o-ring for anode/ceramic, centering tool, cleaning head and Teflon protecting finger).

2. Complete kit for 7 mm anode (anode, ceramic insulation for anode, o-ring for ceramic, black o-ring for anode/ceramic, centering tool, cleaning head, and Teflon protecting finger)

3. Small sample holder kit (include sample holder, o-ring and double face sticking Cu paper)

4. Indium kit (to embedded samples)

5. Special sample holder for analyzing curved surfaces

6. Suitable Nitrogen generator with compressor

7. Suitable chiller unit for cooling the RF source and cathode

8. A general calibration kit consisting of 47 pure elements (NIST traceable standards) as in the specifications. Library for various elements, materials and alloys.

VIII. Spare parts kit for 4 mm anode:

1. 4 mm DiP anodes: 3 Nos.

2. 2 mm DiP anode: 1 No

3. 7 mm DiP anode: 1 No.

4. Ceramic with small O-ring for 4 mm DiP anode: 3 Nos.

5. 8 mm O-ring for ceramic with small O-ring for 4 mm anode (Pack of 10 Nos.)– 15 Pkts.

6. 35 mm Black O-ring for anode/ceramic and ceramic/lamp (set of 2) – 5 sets.

7. Vacuum pump oil – 10 liters

8. Silicon wafer with SiO2 should be provided for DIP usage – 1 No.

9. High pure aluminum (Al) plate should be provided for Daily checking the instrument – 1 No.

IX. Acceptance Criteria:

1. The operational qualification of the instrument for qualitative and quantitative analysis to be checked by analyzing the elements in NIST traceable Certified Reference Materials(multi component metals, ceramics and polymers) .

2. Depth profile capability of the instrument should be demonstrated by analyzing certified materials.

X. Essentials:

1. For imported equipment, there must be Indian company, with proven track record to provide after sales service

2. Comprehensive operation and maintenance manuals containing detailed circuit schematics of all the electronic systems must necessarily be provided in English along with the instrument. All the trouble shooting procedures should be described. Complete mechanical assembly drawings of the instrument also to be provided along with the instrument.

3. Necessary spares for trouble-free operation of the instrument for a period of 5 years to be quoted separately.

4. The utilities required such as power, floor space, environment condition etc., should be clearly provided in the quotation. The equipment shall be guaranteed for a minimum period of five years from the date of commissioning. .

5. Necessary tools for operation and maintenance of all the systems should be supplied.

6. The GDOES system should be installed and commissioned at the purchaser's premises and capabilities of the instrument for smooth operation should be demonstrated by analyzing standard samples.

7. Training: A qualified application expert from OEM shall impart a 5 days training to engineers at customer's site on operation, programming, data analysis and routine maintenance of the GDOES system.

8. The system should be guaranteed for satisfactory performance against manufacturing defects and faulty workmanship for a period of 60 months from the date of commissioning and acceptance of the instrument.

9. After the expiry of warranty period, the supplier or their authorized Indian agents should enter into Annual maintenance contract for subsequent trouble-free operation and the charges for AMC for another 7 years may be quoted separately.

Sr No. 40/ Reference No. 42 (1000016586)

Detailed Description: Integrated Infra-Red Nanoscale Atomic Force Microscope

Nanoscale spectroscopic information at using an Atomic Force Microscope (AFM) cantilever and Tunable IR laser as source. System must provide simultaneous measurement of IR absorption and sample topography from the amplitude and frequency of the AFM cantilever oscillation. The system must be subsequently upgradable to include conductive AFM, KPFM and thermal-conductivity measurements, at later stage. The system should be able to include/ upgrade and use with a temperature controlled stage (-20 - +80 deg C) at a later stage. The system should include a 3-years comprehensive warranty, on-site installation and 6 training sessions spread over the first two years. Full-time, free upgrade for the software associated with the equipment should be made available. Further, any data-analysis software employed should have licenses for use in at least 5 computers. Peer reviewed scientific publications should be provided for proof of all capabilities listed. Details of installation and user-testimonials from at least 5 reputed international labs and universities.

- **System must provide simultaneous measurement of IR absorption, sample topography and mechanical properties from the amplitude and frequency of the cantilever oscillation.**

1. AFM Specification

- **AFM Head/Scanner Material should be made from material for best thermal stability. Invar would be preferred.**
- **AFM Deflection Laser wavelength ~ 920 nm or equivalent**
- **System z-noise floor < 100 pm rms**
- **AC beam deflection detector noise < 80 fm/(root Hz) above 200 kHz**
- **Detector Bandwidth: 6 MHz**
- **Operational Mode: ambient or open liquid cell**
- **Standard modes of operation include – Contact, Tapping, Lateral Force, Force Modulation, Phase Imaging. Kelving Force Probe Microscopy (KPFM) option to be quoted as an option.**
- **AFM head incorporates a parabolic mirror controlled by 3D piezo motor/scanner, allowing the laser to excite the sample and tip from top side. The range of parabolic mirror is 1 mm × 1 mm × 0.8 mm (stepping mode) and 15 µm × 15 µm × 15 µm (scanning mode) with 10 nm resolution, the NA of parabolic mirror is ~0.5.**

- **Inverted optics for photo-induced force microscopy with a 3D piezo objective scanner with ability to accept up to 1.45NA objective lens**

- **The system must be able to generate both fixed wavenumber images and spectrum with the same laser/s. The spectrum on PES (polyethersulfone) must be generated and shown good agreement with a published FTIR spectrum.**

- **Sample size: 80 mm x 80 mm x 15 mm or more**

- **200 number of tips for use in AFM-IR.**

- **Scanner:**

    - **XY range - 50 µm x 50 µm or more**

    - **Dual Z feedback – The AFM feedback mechanism must drive both the sample Z with ≥ 10 µm range and fast tip Z piezo with ≤ 1 µm with 20kHz bandwidth or better. The Z-range for measurement should be aminimum of 6 microns or better. Piezo elements to produce the best AFM feedback while maintaining the tight focus of the excitation laser on the tip apex region.**

    - **Scanner operation Closed loop with capacitive sensors in XY & Z**

    - **Sensor Noise for XY scan sensors < 0.4 nm rms @ 1 kHz bandwidth**

    - **XY-Scanner Linearity < 1% of range**

- **Positioning system**

    - **Coarse positioning range of tip in Z > 10 mm**

    - **XY positioning type of sample at minimum of 6 mm x 6 mm motorized with absolute position sensor**

    - **The system shall include an integrated optical microscope coupled to a 5MP digital camera and computer display. The optical imaging shall be in top view (i.e., looking down on the cantilever), with minimum spatial resolution of 1.5 m**

    - **XY sample positioning repeatability < 1 µm**

    - **Sensor resolution for position sensor < 100 nm rms**

- **Optional - Nanoscale Thermal Analysis capability**

- **Provides localized heating via a nanoscale thermal probe that can be heated upto 400 °C at a heating rate of upto 600,000 °C / min**

- **Provides localized nanoscale phase transition topological measurements using a nanoscale thermal probe that can be heated to temperatures upto 400 °C with sub-100nm resolution, which can be correlated to bulk TMA measurements**

- **Ability to provide local thermal analysis characterization in heterogeneous materials such as blends/composites/multilayer films**

- **Provides high resolution scanning thermal microscopy (SThM)**

2. QCL IR Source

- **Tuning range should cover at least ~ 770 cm^{-1} to >1860 cm^{-1} and 2250 - 4400 cm^{-1} or equivalent. This can be a combination of Quantum Cascade Lasers or OPOs, but should have a minimum spectral line width < 2 cm-1, or equivalent or better. In case of utilizing OPOs, the laser source should have the specifications given in point no 3, given below.**

- **SpectralAccuracy/Repeatability: < 2 cm^{-1} or equivalent or better.**

- **Average Power: 1 - 15 mW over the entire tuning range**

- **Power Stability: < 5% pulse-to-pulse (typical)**

- **Pulse Repetition Frequency: up to 3 MHz;**

- **Pointing Stability: <1 mrad in full tuning range and 40 msec tuning speed in full range to support fast spectrum acquisition with 0.1 s per spectrum and hyperspectral IR imaging with a spectrum over full range in every pixel**

- **Cooling Water cooling for silent operation. Appropriate chillers should be included in the quotation.**

- **Required multiplexer / tuners should be included to cover the complete range of the source as mentioned above.**

- **Beam steering: Motorized tip/tilt**

- **With the Pulsed QCL laser source it should be possible to operate in**

    - **hyperspectral imaging and spectroscopy in the complete tunable range**

3. OPO Laser:

- **OPO Single Housing Picosecond Laser**

- **87 MHz ± 5 MHz PRR;**

- **70 ± 10 ps pulse duration;**

- **Tuning ranges; 2250 cm^{-1} – 4400 cm^{-1}**

- **Spectral resolution: < 4 cm^{-1} or equivalent or better**

- **Acoustic-optic modulator to allow heterodyne AFM measurements with non-contact AFM cantilevers; Any other equivalent technology is acceptable.**

- **Material: single crystal optical germanium or equivalent.**
- **A/R coating: 2.4 – 4.3 microns or equivalent.**
- **Static optical insertion loss: <4 percent;**
- **Center frequency: 80 MHz or better or equivalent;**
- **Frequency shift range: 70-90 MHz or better or equivalent;**
- **Active aperture height: 2mm or better or equivalent;**
- **Optical rise time: 117nsec/mm beam diameter or better or equivalent;**
- **Beam separation: 34.9 / 61. mrad (2.4 / 4.2 microns, 80 MHz) or better or equivalent;**
- **Bragg angle: 17.5 / 30.5 mrad (2.4 / 4.2 microns, 80 MHz) or better or equivalent;**
- **Diffraction efficiency: 85 percent or better or equivalent**
- **RF drive power: 1.5 / 4 watts (2.4 / 4.2 microns, 80 MHz) or better or equivalent;**
- **Optical polarization: horizontal (parallel to base) or better or equivalent;**
- **Input impedance: 50 ohms or better or equivalent;**
- **RF connector: BNC or better or equivalent;**
- **Water cooling: 250 ml/min approximately 23 ºC or better or equivalent; appropriate chillers to be provided**
- **Modulator driver**
- **Motorized laser multiplexer to accommodate OPO and QCL lasers with available additional ports.**
- **Automatic switching between OPO and QCL sources should be possible (if applicable).**

4. Optical access top view for position observation

- **Top optics (for position observation) 20X, 0.42 NA Lens or better or equivalent**
- **Tip-Sample Approach: Automated engagement via 3 stepper motors or equivalent;**
- **Illumination: Software controlled LED**
- **CCD camera: > 5 MP, with pixel image resolution of 210 nm (optical resolution < 1 micron) or better or equivalent.**

5. High-Speed Electronics& Controller Module

- **FPGA-based control electronics has a section dedicated for high speed scanning probe microscopy or equialvent**

- **Sampling Rate: >500 MHz for channels A & B; Channel A dedicated for photodiode detection for high speed AFM or better or equivalent**

- **Lock-in Amplifiers (LIA): 4 independent 2-phase lock-in amplifiers (LIA0 to LIA3). LIA Operation Frequency: Up to 10 MHz. LIA Synchronization: fully synchronized from one clock source. Any equivalent technology is acceptable.**

- **High Speed Sine Wave Generator: Two channels with 160 MHz sampling rates; one reserved for scan generator for high speed AFM. Any equivalent or better technology is acceptable.**

- **Maximum Feedback Throughput: 1 Mps with Dual-Z feedback. Any equivalent technology is acceptable.**

- **Integrated Synchronized Laser Driver. Any equivalent technology is acceptable.**

- **Standard DAC Channels: 15 channels, 24-bit, 156 kHz data rate**

- **Standard ADC Channels: 8 channel: 24-bit, 156 kHz data rate**

- **Noise Floor for Scan HV-Amplifiers: 140 uVrms for 150V full range**

- **TTL Signal Generator: Two flexible TTL signal generators (with 160 MHz sampling rate) with adjustable duty cycle and DC offset for direct current modulation of laser diodes or for input to Bragg cells**

- **Flexible Lock-in Referencing: The LIAs can be phase locked to any other LIA or at any calculated frequencies from the other LIAs**

- **Digital Counter Input: Input for APD and PMT for low-lighting imaging**

6. Image Acquisition Software: Supported modes/features include:

- **Contact and AC AFM**

- **PLL feedback (for high Q sensors such as tuning-fork)**

- **Ultrafast Dual-Z feedback**

- **Q-control**

- **Bi-modal force gradient imaging for linear and non-linear PiFM**

- **Sideband force gradient imaging (for KPFM via electric force gradient detection)**

- **Concurrent acquisition of 26 channels in Dual-Z configuration and 40 channels in Slow-Z configuration**

- **Concurrent acquisition of 4 channels for each spectroscopy mode which may include**

- **vs gap distance**
- **vs bias with and without feedback**
- **step response to voltage response with and without feedback**
- **Should have capability to locate and zoom in/out of pre-acquired images on the same sample.**

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- **Contact and AC AFM**
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- **Concurrent acquisition of 4 channels for each spectroscopy mode which may include**
- **vs gap distance**
- **vs bias with and without feedback**
- **step response to voltage response with and without feedback**
- **Should have capability to locate and zoom in/out of pre-acquired images on the same sample.**

8. Computer:

- **Mounted in a 19″ rack.**
- **Minimum configuration includes 3.4GHz Quad Core, 256GB SSD and 2000GB HD combination, 26″ or larger monitor, 8X USB ports, Windows 10 Professional**

9. Environmental

- **Suitable Active Vibration Isolation system with active bandwidth 0.6 to 200 Hz**
- **Acoustic Enclosure with capability to keep temperature controlled to +/- 0.2C.**
- **Dry Air filtration set up to provide quiet, clean, and water-absorption-free operation with customer provided compressed air connection.**

10.Acceptance Criteria

- **All the lasers must be capable of AFM-IR by cantilever detection for both fixed wavenumber imaging and single and multipoint full range spectra. The spatial resolution of AFM IR should be at least 10 nm. The 10 nm spatial resolution must be demonstrated during the site acceptance test by imaging a PS-PMMA block copolymer with a half pitch of 21 nm or smaller; the PS block should be acquired at ~ 1492 cm-1 and ~ 2956 cm-1 and PMMA at ~ 1733 cm-1 and ~ 2853 cm-1 along with AFM topography and phase. Any other equivalent demonstration of spatial resolution and spectral resolution with other standard sample is acceptable.**

Sr No. 41/ Reference No. 43

Detailed Description: ECVT Multiphase fiow system

Technical Specifications of ECVT System

One Multi-dimensional ECVT system for 3D imaging in applications ranging from multi-phase flows (water-steam two-phase flows, liquid nitrogen-vapor nitrogen cryogenic two-phase flows, three-phase flows, granular flows, slurry bubble column, fluidized bed, bubble column) to combustion studies.

The Multidimensional ECVT system should have the following capabilities/ features:

1. 3D imaging of the various phases in the process under study. For example, 3D imaging of water and steam distribution in a water-steam two-phase flow process.

2. Measurement of Volume fraction of various phases with at least 1% sensitivity.

3. Flow velocity measurement.

4. Velocimetry of objects.

5. Cross-section imaging (at least 20 slices on each axis or better).

6. Spatial resolution of 2% of the volume or better.

7. High-speed imaging at maximum possible spatial resolution. The maximum imaging speeds upto ”800 fps to 1000 fps should be achievable with the system.

8. The system should be scalable for use on a 25mm to 1500 mm diameter pipe. The pipe diameters for which ECVT sensors are required as part of the current requirement are given in Table 1.

9. Data analysis using MATLAB built toolbox.

ECVT Sensor Specifications:

Six ECVT sensors required for use with pipes of diameters given in Table 1.

All ECVT Sensors must be usable in both horizontal and vertical pipe orientations.

Table 1: Pipe diameters for ECVT clamp-on style sensors :

Sl No	Pipe Outer Diameter, mm
1	25
2	50
3	100
4	150
5	200
6	250

The system should be capable of imaging the process over an axial length of at least in the range 200 mm to 300 mm.

Process Conditions and Operating Environment:

The ECVT system is required for applications ranging from multiphase flows to combustion studies.

Table 2: Process Conditions :

Process pressure 1 – 100 bar

Process temperature -200 0C (73K) to 1000 0C (1273K)

Table 3: Operating Environment :

Location	**Indoor**
Temperature	**20 - 30 0C**
Pressure	**1 atm**
Humidity	**50 - 80 %**
Available Power Supply	**220 VAC, Single phase, 50Hz. Indian standard**

Data Acquisition System (DAS) and Data Analytics Software Specifications:

One standard multi-dimensional ECVT DAS including cables, power cord, data acquisition and analytics software to be provided as part of the ECVT system. The cables from DAS to the sensors should be of appropriate length to enable remote analysis of the process under study. The data acquisition and analytics software should have the following features:

1. Compatibility with MATLAB. At least one license for Matlab toolbox to be provided.

2. One high end workstation with latest configurations pre-loaded with the data acquisition and analytics software.

3. The software should have the following real time features:

- **Raw data view**
- **Normalized data view**
- **ECVT data collection**

4. Post Processing features should include:

- **Raw data view**
- **Normalized data view**
- **Full 3D Reconstruction and Viewing Options**
- **Viewing Plane Manipulation**
- **The software should have direct as well as iterative reconstruction techniques, viz.,**

Linear Back Projection (LBP) Reconstruction Technique, Landweber (iterative Linear Back Projection) Reconstruction Technique and Neural Network Multi-Criterion Optimization Imaging Reconstruction Technique.

Customer support and training:

1. Customer support (Annual maintenance for three (03) years) should be provided.

2. Commissioning & training (remote/onsite) should be provided.

3. Warranty of at least one year (01) on the multidimensional ECVT system (from the date of installation of the system at IIT Bombay) with provision of extended warranty.

Sr No. 42/ Reference No. 45 (Revised)

Detailed Description: XRD-Mill

The XRD-Mill needs to be suitable for the grinding cement based samples for subsequent X-ray diffraction (XRD)

Grinding jar sizes: 125 ml

2 grinding jars with screw top lid of polypropylene, 1 pouring lid, 1 loading Device.

Material of grinding tools: Corundum

Corundum, grinding elements - 3 sets (1 set = 48 identical cylindrical grinding elements)

Grinding sets: RS 200 – 250 ml Hardened steel - 1 set.

No. of grinding stations: one

Feed materials: medium-hard, hard, brittle, fibrous.

Material feed size < 0.5 mm, Final fineness: < 1 µm

Speed at 50 Hz (60 Hz): 1,050, 1,200, 1,350, 1,500 min^{-1}

Dry and wet grinding

The grinding time for optimum micronization shall be less than 30 minutes. A typical sample volume is between 2 to 4 ml.

Sr No 43/ Reference No. 46

Detailed Description: CdTe X-ray soft and hard detector

CdTe X-ray soft and hard detector, range 5 keV to 150 keV, area more than 25 sq mm, thickness 1 mm or more, digital output, energy resolution better than 10% FWHM at 122 keV Co line, compact, no external high voltage requirement.

Technical requirements for X-ray detector

Overall Features

4. Built-in thermoelectric cooler for low-noise application
5. Low-power (< 5 W)
6. Integrated pulse processor, multi-channel analyser etc to give digital output.
7. Must have PC interface with control, data acquisition, and display software.
8. API should be available for building custom applications.

Performance Specifications

- Lower energy limit: ≤ 5 keV
- Higher energy limit: ≥150 keV
- Sensor area: ≥ 25 mm^2
- Thickness: ≥ 1 mm
- Energy resolution: FWHM ≤ 10% at 122 keV (Co-57 line)
- Maximum count rate: ≥ 10^5 counts/second
- Operating temperature: -20ºC to +50ºC (suitable for thermal chamber)

Connections

9. Minimal connections: only power and data
10. Data output: both USB and Ethernet connectivity required
11. Power: must operate on low voltage DC power (≤15 V)
12. No high voltage power will be provided externally

Size & weight

9. Compact detector (external dimensions under 20 cm x 10 cm x 5 cm)
10. Weight: < 200 gm

Conditions:

24. Demonstration of the technical parameters mentioned in the tender, if requested by the committee for technical evaluation of the quoted instrument, will be required.
25. Participating vendor should have minimum 5 Years of Experience of supplying and after-sales service support in similar Instruments in premier Government Institutes or Government Organisations in India (vendor must supply supporting documents along-with contact details of the users if requested).

Sr No. 44/ Reference No. 47

Detailed Description: Name of the equipment: Analytical UltraCentrifuge (AUC)

Analytical Ultra Centrifuge Analytical Ultra Centrifuge AUC compatible with Absorbance/ Interference (A/I) mode detection.

• To perform Sedimentation Velocity <(>&<)> Equilibrium studies.

• To measure a change in molecular weight or conformation based on its response to centrifugal force

• To detect, measure, record and analyze the movement of molecules in solution under influence of centrifugal field • For in-solution characterization of proteins, oligomers, aggregates, particles, colloids <(>&<)> nano-structures

It should have following specifications:

Speed

• Set speed - 1,000 — 60,000 RPM or similar with 100 RPM increments

• It should display Speed — Actual measured rotor speed in 10-rpm increments below 1,000 RPM and 100 RPM increments ≥1,000 RPM.

• Speed control: — Actual measured rotor speed, ± 2 RPM at steady state (1,000 RPM to rated speed)

• It should have option for Braking speed Time Set time: — Up to 1000 hrs (approx.), including Hold runs — Up to 3.94780 x 1014 or similar radians squared per second in ω2t mode

• Time display: — Indicates time remaining and time elapsed in method scan.

• Time accuracy: — ± 50 ppm (5 seconds/day) or similar Temperature Set temperature: — 4 to 40°C in 1°C increments at <(><<)>25°C ambient temperature

• Temperature display: — Actual rotor temperature in 0.1°C increments

• Ambient temperature range: — 10 to 30°C

• Humidity restrictions: — <(><<)>80% at <(><<)>30°C (non-condensing)

• It must include Condensation removal: Scanning UV/VIS Absorbance Optical System It should have 10 μJM Xenon Flash Absorbance optics or equivalent Wavelength range – 180 to 800 nm Wavelength precision - ± 0.5 nm Photometric display range – 0 to 3 absorption Units Usable concentration range – 0 .005 - ~50 mg/mL

• Wavelength scan mode — wavelength increment step size 1.0 nm, from 190 nm to 800 nm Interference Optical System Rayleigh interference detection Usable concentration range 0.01 to 20mg/mL Wavelength – 660 nm Laser - Red laser120 mW Diode Scan Rate - approximately every 5 seconds Interferometer precision - approximately ± 0.008 fringe Analytical Rotors Upto 8 samples per run; max speed 60K RPM Analytical cell, torque stand, counterbalance kit, accessory kit, and cell housing kit

1. maximum speed of 60,000 RPM and up to eight cells and a counterbalance can be run at one time.

2. maximum speed of 50,000 RPM and up to seven cells and a counterbalance can be run at one time. Sample cells Double sector cells should withstand 60K RPM; also, required cells for equilibrium/kinetic studies; Quartz and Sapphire windows. Display system Speed, time, method setup and temperature indicators. Data storage and transfer 1TB with fast data transfer connectors like HDMI; safe networking adaptors; Data processing

• Automated and manual; remote connection capabilities

• Including comprehensive data analysis package with scripts. Additional licence for data analysis software PC monitor:

High resolution with capability for extension Training:

1. One users should be trained properly and extensively at the company site.

2. Must include an intense training by a company expert for all mode of data recording and analysis after installation

3. Periodic training by local engineers for usage of the instrument UPS: 10 KVA or appropriate for the instrument Warranty: 5 Years of CMC (all motors, display, pump and all electronic boards should be covered).

Accessories:

1. Plug Gasket, Red Polyethylene (Pkg/100) QTY:03

2. Washer, Screw Ring (Pkg of 6) QTY:10

3. Plug, Housing (Pkg of 6) QTY:10

4. Window Gasket, White Vinylite (Pkg/100) QTY:06

5. Liner, Window (Pkg of 6) QTY:06

6. Rotor Cleaning Kit QTY:01

7. Cell Housing and Window Assembly Kit, for double sector cells, 12mm; plane quartz windows QTY:24

8. Window Holder, Upper, for Plane Window QTY:24

9. Screw Ring, Cell Housing QTY:24

10. Centerpiece, Double Sector, Charcoal-Filled Epon, 12mm QTY:24

11. An-60Ti, Titanium Analytical Rotor QTY:01

12. Kit, XL-A Photometric Chk Solution QTY:02

13. Ultracentrifuge OQ QTY:01

14. Window, Plane Quartz Replacement QTY:24

15. Centerpiece, double sector, aluminum, 12mm QTY:06

16. Sapphire Window Replacement QTY:24

17. Cabinet, 18 drawer QTY:01

18. Torque stand assy for XL-A Cells QTY:02

19. Screwdriver, Cell Plug QTY:01

20. An-50 Ti Overspeed Disk QTY:01

21. Overspeed Disc, An-80 Ti Rotor QTY:01

22. Filter Kit, HEPA QTY:01

23. Cell Alignment Removal Tool QTY:02

24. Spinkote Lubricant, 2 oz tube QTY:01

25. Hsg Kit, 12 mm, 6-Channel QTY:06

26. Centerpiece, Equilibrium QTY:01

27. Allegra 64R centrifuge QTY:01

28. C0650 Fixed Angle Rotor Assembly QTY:01

29. Adapter, Conical 15mL, C0650 Rotor QTY:06

30. F0630 Fixed Angle Rotor Assembly QTY:01

31. Torque Stand QTY:02 32.Extra Xenon flash lamp QTY:01

Sr No. 45/ Reference No. 48

Detailed Description: Multi-cultivator for cultivation of photosynthetic organisms:

1. Unit comprised of 8-12 cultivation test tubes. With the working volume ranging between 50-100ml.

2. Cool white LED illumination up to 3000µmol/m^2smaximum. Adjustable from 0 to 100% and separately controllable illumination for each tube.

3. Static or dynamic light regime (pulse and daylight mimic)

4. Manual aeration which allows the sparing of required gases and assures equal distribution across all the tubes.

5. Thermostatic water bath with temperature range between 20-55ºC

6. Inbuilt optical density measurement at 680nm and 720nm separate for each test tube. Soft-ware through which online data can be visualized and exportable to editable format like to excel.

7. Periodically OD, temperature and time to be measured at user defined time interval.

8. Sampling port for each tube separately while the instrument is on.

Note:

1. Comprehensive warranty for 24 months and AMC for 12 months post the warranty period.

2. We need a well-tested and validated standard equipment and not custom made equipment. The equipment should come with a certificate of analysis and conformity.

3. Printed brochure for the standard unit with specifications, list of installations in India and abroad, and addresses of authorized service centres in India.

Sr No. 46/ Reference No. 49

Detailed Description: Particle Size Analyzer

- System should provide automated, in situ, real-time droplet size analysis of high concentration aerosols and sprays from a robust, easy-to-use platform.
- Should be adequately sensitive to changes in the droplet size distribution.
- Should produce size distribution data rapidly and present it in a format that is easy to understand as per the standard practices (probability density function).
- Should provide an instant understanding of the evolution of the spray over time.
- Should have capability to do various statistical analysis within the software.
- Laser based Particle/droplet size range: "0.1µm to 2000µm"
- Measurement of sizes of moving droplets of liquids or solid particulate matter dispersed in air or any gaseous medium.
- Data Acquisition rate: Greater than or equal to 10 kHz for unsteady spray measurements
- Accuracy: +/- 1% or better.
- Precision: +/- 1% or better
- Measurement triggering: Both internal and external.
- Operating temperature: 15-40°C or higher.
- Humidity: 40-80% RH.
- Operation voltage: 100-240 VAC, 50 Hz.
- Latest upgraded Licensed Software should be installed on required computer specifications on Windows 10 operating platform and supply along with complete system with complete accessories.

Sr No. 47/ Reference No. 50

Detailed Description: Single Tilt Heating Holder and Single Tilt Straining Holder

Single Tilt Heating Holder:

i) Proposed Single Tilt Heating Holder should be compatible with TF Themis 300 TEM with Super-Twin Pole piece.

ii) It should have Hex-ring specimen clamping system for mounting specimen and to ensure good thermal contact between specimen and furnace.

iii) Temperature at specimen holder tip should be maintained near the temperature of the specimen stage using water-cooled specimen rod.

iv) Max. operating temperature: 1300 ^{0}C

v) Resolution at 00 tilt and ≤500 ^{0}C : 0.34 nm

vi) Specimen size : 3 mm

vii) Observable area at 00 tilt : 3.24 mm^2 and 2.03 mm (dia)

viii) Max. grid thickness : 200 μm

ix) Standard holder tip material : Beryllium copper (suggested)

x) The complete holder set-up should include Water Circulator and Temperature controller.

Single Tilt Straining Holder:

i) Proposed Single Tilt Straining Holder should be compatible with TF Themis 300 TEM with Super-Twin Pole piece.

ii) A side entry type, single tilt straining holder for elongating electron transparent specimens at controlled rates in TEM.

iii) The specimen holder tip should have an appropriate opening with two points for securing the specimen. Should utilize Hex-lock clamping mechanism to firmly and securely holding each end of the specimen in place, during elongation.

iv) Appropriate controller to apply a constant elongation rate in the range of ~2.0 μm/s.

v) Start and stop of elongation with press of a button. The controller should display crosshead displacements with a resolution of at least 1 μm and should have an auto zero button to return the crosshead to either its original zero position or an offset zero position.

vi) Should include a specimen rod stand to facilitate specimen loading under a stereo microscope. Appropriate Hex-locks, Hex-Lick tools and clamping plates must be provided.

vii) Maximum drift rate at 0° tilt: 1.5 nm/min

viii) Resolution at 0° tilt: 0.34 nm

ix) Specimen size (maximum): 2.5 x 11.5 mm (L x H)

x) Observable area at 0º tilt: 5.0 (mm^2)

xi) Max. sample thickness: 400 μm