

Technical Specifications Variable temperature cryogenic microscopy platform

General Description: The following key components should be included:

- Variable temperature cryogen-free cryostat with suitable optical windows
 - Including an optical table, necessary vacuum pumps and compressor with control systems
 - Setup should allow easy access for sample exchange via removal of a vacuum chamber
 - SMA feedthroughs with connectors for microwave
 - Extremely low vibration levels to enable diffraction-limited microscopy
 - Featuring Automated cooldown and warmup
- Low temperature compatible XYZ positioning + scanning stage for the sample
- Low temperature objective with positioning stage to allow focusing
- XYZ (translation) and two Rotation stages positioning system for a magnet in room temperature

Detailed specifications are for various components are provided below and must be satisfied

S.No.	System/Component/Operation	Description
1.	Cyrostat with Cryogen-free operation along with necessary vacuum pumps, compressors, and control software	<ul style="list-style-type: none"> • System should be fully cryogen-free, i.e., no requirement of liquid Helium and/or liquid Nitrogen at any point of time • Cooldown and warmup of the system and the temperature control should be fully automated • The system should include a water-cooled compressor to avoid temperature fluctuations in the laboratory • The system must include a water-cooled compressor. Compressor specifications: single phase, 230/240V, 50Hz, ≥ 2.6 kW@50Hz, ≥ 2.5L/min cooling water. • The system should have a remote computer control interface along with a local touch-screen control. Software for remote control should be provided along with libraries for integration with Labview, Python and C++. Remote controls should be provided for temperature control and motion of stages. • The vacuum system must be fully automated including turbo-pump control.
2.	Optical table	<ol style="list-style-type: none"> 1. The cryo-cooler should be fully integrated into an optical table with the following specifications: <ul style="list-style-type: none"> • Size: 1200 mm X 1800 mm • Pneumatic Vibration Isolators with automatic re-leveling and two tuned dampers • Facesheet: SS 316 steel top • Thickness: ≥ 300 mm • Mounting holes: Metric (M6-1.0 holes on 25mm grid, 12.5 mm borders)

		<p>2. No parts of the cryostat except for the sample space, vacuum chamber and related mounts must be mounted on the table</p>
3.	<p>Vacuum chamber</p> <ul style="list-style-type: none"> • Number of optical windows • Window material • Microwave feedthrough 	<p>Suitable vacuum chamber should be provided to host a low temperature compatible objective along with the nano-positioning stages for the movement of sample and objective. Vacuum chamber should allow positioners, scanners stack, Including all necessary mounting parts for thermal connection between a cold plate and objective. Objective should be mounted horizontally.</p> <p>2 windows for optical measurements in transmission mode and one for inspection</p> <p>AR coating @ 400-1000 nm R avg. < 0.7% Transmitted Wavefront Distortion < $\lambda/10$ Surface Quality: 20/10 (Scratch/Dig)</p> <p>2 heat sunk coaxial lines, max attenuation at 4 K: 3.5 dB/m @ 20 GHz with vacuum feedthrough, 2 SMA connectors, thermalization kit (on cold shield), no clamping of wires</p>
4.	<p>Temperature Control</p> <ul style="list-style-type: none"> • Temperature range • Temperature stability • Cooling power 	<p>Should cover at least 4 K-300 K</p> <p>< 20 mK (peak-to-peak)</p> <p>> 140 mW at 5 K</p>
5.	<p>Vibrational Stability of cold plate</p>	<p>< 5 nm peak-peak up to 1.5 KHz (measured at max. cooling power)</p>
6.	<p>Sample Space</p> <ul style="list-style-type: none"> • Sample space • Sample environment • Sample movement 	<p>Enough to accommodate to low temp XYZ positioners, scanner and the sample stage, low temp objective and stages for it</p> <ul style="list-style-type: none"> • Sample should be in cryogenic vacuum space. Base pressure in sample chamber should be < 5×10^{-6} mbar and leak rate should not lead to condensation • Non-cryogenic vacuum before cooldown < 1×10^{-3} mbar • Oil-free Vacuum pumps with an appropriate vacuum gauge should be provided <p>Movement of the sample in 3-axes should be accomplished by 3 nano-positioning stages in closed loop control and 1 scanner unit with the following configurations:</p> <ul style="list-style-type: none"> ▪ <u>Horizontal and vertical motion stages (x, y and z stages):</u> <ul style="list-style-type: none"> ❖ Non-magnetic and titanium ❖ Footprint: ≤ 25 mm X 25mm ❖ Travel range x/y: ≥ 5 mm ❖ Travel range z: ≥ 3 mm ❖ Integrated resistive encoder

	<ul style="list-style-type: none"> • Spare screws and driver for positioning system • Electrical access • Sample exchange • Thermal coupling device • Compatibility with magnetic field 	<ul style="list-style-type: none"> ❖ Position resolution: ≤ 200 nm ❖ Repeatability: $2 \mu\text{m}$ for low temperature conditions ▪ <u>xyz scanner unit:</u> <ul style="list-style-type: none"> ❖ Non-magnetic and titanium ❖ Scan range: $50 \mu\text{m} \times 50 \mu\text{m} \times 24 \mu\text{m}$ (Room Temperature) ❖ $30 \mu\text{m} \times 30 \mu\text{m} \times 15 \mu\text{m}$ (Low Temperature) <p>Spare kit of screws and drivers as needed for the positioners should be provided</p> <p>Fixed, thermalized plugs at 4K, > 30 electrical contacts, no clamping of wires</p> <p>Easy access for sample exchange via removal of vacuum shroud</p> <ul style="list-style-type: none"> • Thermal coupling device, with integrated Cernox • temperature sensor and heater compatible with needed temperature range and non-magnetic model • thermal anchoring of a sample to coldfinger, compatible with positioners and scanners, <p>Sample should be < 15 mm away from the window to enable application of sufficient magnetic field</p>
7.	<p>Low temperature Objective</p> <ul style="list-style-type: none"> • Optical specifications of the objective • Objective movement 	<ul style="list-style-type: none"> • A low temperature apochromatic objective with NA > 0.8 should be provided. • There should not be any shield between the sample and the objective, and the objective should be maintained at 4K • Objective should be mounted horizontally • Numerical aperture NA > 0.8 • Working distance WD > 0.5 mm • Monochromatic range (total transmission $> 80\%$) 400-1000nm • Apochromatic range (chromatic focal shift $< +/-$ depth of focus) 525 - 680 nm <p>Suitable nano-positioning stage should be provided for the movement of objective with the following specifications to keep the sample position fixed while focussing the objective:</p> <ul style="list-style-type: none"> ▪ Non-magnetic and made from titanium and linear ceramics bearings ▪ Maximum load (horizontal mounting orientation): 20N ▪ Maximum load (vertical mounting orientation): 2N ▪ Travel range: > 5 mm ▪ Integrated low-temp compatible positioner encoder ▪ Position resolution: 200 nm ▪ Repeatability: $2 \mu\text{m}$ for Low temperature
8.	Electronics	

	<p>Electronics for driving Positioners with encoders</p> <p>Electronics for Scanners and objective positioner</p>	<p>Electronics for the control of up to 3 nanopositioners in closed-loop control, Incl. 3 positioners connection cables, incl. 1 USB cable, incl. specific mains cable compatible with India's power supply (220 V, 50 Hz) and Indian power socket</p> <p>Base Unit should be Modular design, allows for the integration of up to seven positioning modules and manual control via a touchscreen</p> <p>3 scanning modules 1 positioning module</p>
9.	Room Temperature Positioners & Rotators	<ul style="list-style-type: none"> • 2 quantity (for lateral/horizontal direction) Nano-positioner with integrated position encoder (with resolution of ≤ 5 nm and repeatability of 50 nm) & crossed-roller bearings, Travel Range: 20mm, Load capacity: ≥ 9 kg (XY), • 1 quantity (vertical direction) Nano-positioner with position encoder & crossed roller bearings, Travel range: 5mm or more, and load capacity: 8N (all vertical load) • 2 quantity (rotator) Rotator made of Aluminum with position encoders & bearings, Travel range: 360 ° endless • Weight/load specifications: torque: 2N-cm, load: 2Kg
10.	Electronics (for Room Temperature positioners & Rotators), Software and Assembly	<ul style="list-style-type: none"> • 2 quantity Motion controllers for driving upto 3 positioners (for closed loop). Each Controller should be accompanied with 1 Ethernet cable, 1 USB 2 Ethernet adaptor and 1 power supply compatible with India • Software to control the motion of the stages • Appropriate accessories should be offered for the rotator to be mounted into vertical direction or horizontal position
11.	Annual Maintenance	<ul style="list-style-type: none"> • AMC for 2 years starting from the end of warranty with one visit of a qualified technician per year
Optional items		
1.	Additional vacuum chamber compatible with the base cryostat	<ul style="list-style-type: none"> • Chamber should be able to host a low temperature compatible objective vertically and allow for horizontal sample placement • Should be compatible with Low Temperature & scanners • should include all necessary mounting • parts for z focus and thermal connection • between cold plate and objective • 5 optical windows (4 on the sides and one on top should be provided)
2.	Extended warranty for 1 year	<ul style="list-style-type: none"> • The vendor should quote for extended 1 yr warranty
3.	Recirculating water chiller	<ul style="list-style-type: none"> • Suitable chiller compatible with the cryostat and compressor should be quoted

Other compulsory requirements:

1. Tender applications can be submitted either by the foreign manufacturer or by his India agent/Distributor. If the foreign manufacturer submits tender application, they should submit their list of authorised agents in India. In case the Indian agents/distributors submit the tenders, then they should enclose the authentication letter from their foreign manufacturer.
2. Vendor should have nationally or globally installed at least four cryostats of the same base model being quoted in the tender. The vendor should provide detailed information, for at least four relevant installations of where these systems have been installed.
3. Along with their technical bid, the vendor should include brochure for the products being quoted. Additional specification-sheet for the components, if needed, should also be included. Data should be provided for critical specifications- 1) Temperature range, base pressure, and vibration levels of the cryostat and 2) Range, resolution and repeatability of positioners, to show the ability.
4. Factory test report of the **specific unit being provided to the customer** should be provided. These should show successful operation of the cryostat and the positioners, meeting specification.
5. The equipment will be considered successfully installed if the following operations of the components are demonstrated to the desired specifications provided above:

Component	Requirement
Cryostat (Including optical table, pumps, and compressor)	<ul style="list-style-type: none">• Operation of the compressor• Installation of the cryostat on the table• Successful operation of the optical table vibration isolation• Cooldown of cryostat to base temperature• Demonstrate temperature control• Demonstration of base pressure
Positioners and their controlling electronics	<ul style="list-style-type: none">• Mounting and connection of positioners• Mounting of the objective• Setup of the electronics and connection to the cryostat• Demonstration of open and closed loop positioner movement at room temperature• Demonstration of open and closed loop positioner movement at low temperature