

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE
2A & 2B , Raja S.C. Mullick Road, Jadavpur, Kolkata-700032

NIT No. :IACS/OCJD/2021-22/92

Date: 17.11.21

Sealed tender in two bids system (Technical bid and Price bid) is invited from bonafide, resourceful and eligible manufacturer/exclusive distributor/vendors for **Scanning Probe Microscopy**.

Part-I (Technical Bid) of the tender should contain technical specifications in detail as well as commercial terms and conditions. Part-II (Price Bid) should clearly indicate group-wise price, if needed, as mentioned in the technical bid. The Technical Bid and Price Bid are to be submitted in separately sealed envelopes, distinctly marked accordingly and both to be put inside another envelope, that should be sealed and superscribed with tender notice no. and due date. The bidders may submit bids duly signed in their own letterheads.

Completed tender bids should reach the office of the **Registrar, Indian Association for the Cultivation of Science (IACS), 2A & 2B Raja S. C. Mullick Road, Jadavpur, Kolkata-700032** on or before the scheduled date and time specified below:

Tender Notice No.	IACS/OCJD/2021-22/92, 17.11.21
Last date and time of submitting tender	15/12/2021, within 3.00 PM
Pre-bid meeting(date, time & place) to discuss technical specification	30/11/2021, 1.00 PM (Room No. 107A, Main Building, IACS)
Date and time of opening tender (Technical Bids)	17/12/2021, 2.30 PM
Place of opening tender	Room No. 107A, Main Building, IACS
Date and time of opening of Price Bid	The Price Bids of the bidders qualifying the technical bid will only be opened, the date of which will be intimated to the short-listed bidders at their email addresses. The rest of the bids will be rejected.
Contact	Email: ocjd@iacs.res.in Tel.+91 33 2473 4971 [Ext 1405]

The technical bids will be opened first to judge/evaluate the technical specifications of the said instrument and thereafter the price bids of only technically qualified bidders will be opened.

Technical Bid Evaluation: The Technical Bids will be evaluated in the presence of the representatives of intending bidders who will be able to clarify technical aspects of their bids, if any, required by the Technical Evaluation Team.

Opening of price-bid: The Price Bids of the bidders qualifying the technical bid will only be opened, the date of which will be intimated to the short-listed bidders at their email addresses. The rest of the bids will be rejected.

Please note that IACS will not provide any accommodation or reimburse any expenses to any of the bidders for attending opening of technical bid.

Quotations received incomplete or beyond the stipulated time will be summarily rejected.

Bidders should submit their past experience for supplying and successful installation of similar units to other research Institutes/Universities/other organizations in India and abroad. Please provide documentary proofs of such successful installation and supportive documents that the instruments are running successfully.

The equipment is estimated to cost of Rs. 145,00,000/-
(This estimate however is mentioned merely as rough guide and indicative)

1. TECHNICAL BID

The technical bid should contain technical specifications and should be kept in a separate sealed envelope duly superscribed as 'TECHNICAL BID' on the outer cover of the envelop as already detailed above. **It should be clearly mentioned on the envelope as "Technical Specification for Scanning Probe Microscopy"**.

Tender specifications for Scanning Probe Microscopy

1. Instrument Resolution:

- 1.1. The instrument must have demonstrated true atomic resolution (defined as point defects repeated over several frames) including scanning in water or in a liquid with similar relevant physical properties as water in a non-contact or tapping measurement mode over several frames of imaging. The tenderer must include actual technical data and the conditions under which the data was acquired so that the committee may evaluate the qualifications of the proposed instrument. An unsubstantiated claim of being technically compliant will not be considered.

2. Instrument Geometry:

- 2.1. The microscope must be a sample scanning system in XY and tip scanning in Z
- 2.2. The XY scanner must be separate from the Z scanner to eliminate the "bowing" artefact commonly seen in Piezo tube based (XYZ scanners) AFM systems.
- 2.3. The optical lever assembly (laser, optics and detector) must be a fixed geometry (defined as no motion between components) during scanning.
- 2.4. The tip-sample mechanical loop must not include the optical lever (laser, optics and detector).
- 2.5. The Scanner, Optical Light Source and Optical Camera assemblies must all be modular and upgradeable or user selectable.
- 2.6. Each axis of motion is independently actuated using its own piezo stack and flexure stage. Should have Integrated LVDT / equivalent position sensors in all three axes provide seamless closed loop operation.
- 2.7. Sample size of upto 15 mm dia and 7 mm thickness

3. **Operation Modes:** The microscope must be capable of the following scanning modes, each of which requires at minimum that the signals noted in the corresponding parentheses be recordable simultaneously. Each of these signals must be recorded in both trace and retrace

scan directions. Here, auxiliary signals refer to external inputs that are independent of the microscope:

- 3.1. Scanning Tunnelling Microscope with same scanner
- 3.2. Contact Mode
- 3.3. Electric Force Microscopy (EFM)
- 3.4. Force Curve Mode
- 3.5. Force Mapping Mode (Force Volume)
- 3.6. Force Modulation
- 3.7. Frequency Modulation
- 3.8. Fluid imaging
- 3.9. Kelvin Probe Force Microscopy (KPFM)
- 3.10. Lateral Force Mode (LFM)
- 3.11. Magnetic Force Microscopy (MFM)
- 3.12. Nanolithography/ Nanomanipulation
- 3.13. Phase Imaging
- 3.14. Piezoresponse Force Microscopy (PFM)
- 3.15. Switching Spectroscopy PFM
- 3.16. Tapping Mode (AC Mode)
- 3.17. Tapping Mode with Q-control
- 3.18. Vector PFM
- 3.19. Two frequency mode - Amplitude and phase response at a second frequency (often a higher mode) to provide useful additional image contrast while the primary topographic feedback loop runs at the fundamental frequency. In order to optimize signal to-noise the second frequency must be driven simultaneously along with the fundamental resonance.
- 3.20. Resonance tracking mode - Operating on resonance to improve the measurement signal to noise for operating modes like piezo response force microscopy and contact resonance imaging.
- 3.21. The AFM system must be able to image samples and perform measurements in air and in liquid and even for commonly used electrical modes in air like EFM, PFM & KPFM etc using the same cantilever holder. The cantilever holder must be compatible with most commercial cantilevers.
- 3.22. Further for our specific applications a suitable fluid cell should be included for doing DNA AFM.
- 3.23. Following should the minimal quantity of probes which should be included:
- 3.24. 10 AC Mode / Non Contact Mode / Force Spectroscopy Imaging in Air Probes with resonance frequency ~ 300 kHz, spring constant ~ 26 N/m
- 3.25. 10 AC Mode / Non Contact Mode / Force Spectroscopy Imaging in Air Probes with resonance frequency ~ 70 kHz, spring constant ~ 2 N/m
- 3.26. 10 Contact Mode probes
- 3.27. 10 Nos Probes for imaging in fluids
- 3.28. 10 Nos Electrical characterization probes
- 3.29. 20 STM probes
- 3.30. All probes with type and quantity should be listed clearly in the offer and should also be offered as optional for us to choose additional quantity required.

4. System Noise

- 4.1. DC Height Noise must be less than 15pm in a 0.1Hz to 1kHz BW (<5pm in quiet environments). DC Height Noise is defined here as the apparent movement of a moderately stiff cantilever (Olympus TR800, 100 μ m, $k=0.61$ N/m, or equivalent) in static contact with a hard surface with the Z feedback loop turned down to limit the bandwidth to below 0.1 Hz so that it doesn't affect the measurement. It is not acceptable to make this noise based on the Height signal; this test is too poorly defined for the purposes of comparing systems since adjusting the gains affects the measurement.
- 4.2. AC Height Noise must be less than 15pm in a 0.1Hz to 1kHz BW. AC Height Noise is analogous to the DC Height Noise, by using a very stiff AC-mode cantilever (Olympus AC160, 160m, $k = 42$ N/m, or equivalent) driven at resonance tapping on a hard surface and measuring the apparent amplitude of the cantilever. The tenderer must include actual technical data and clearly mention the conditions under which the data was acquired so that the committee may evaluate the qualifications of the proposed instrument. An unsubstantiated claim of being technically compliant will not be considered.
- 4.3. The offered instrument must be compatible with universal cantilevers.

5. Optical Lever Arm: Light Source(s) and Photo detector.

- 5.1. Spot Size: User selectable and exchangeable. Both RF modulated laser diode and low coherence super luminescent diode (SLD) light sources should be available with the system. One focused spot sizes of 10x30 μ m should be offered with the system as standard and other options including RF Modulated and SLD should be offered as an option.
- 5.2. The instrument must allow for the interchange of optical light sources. At least one light source should be included with the offered configuration. Others available should be offered optionally.
- 5.3. The instrument's DC Detector Noise must be less than 5pm in a 0.1Hz to 1 kHz BW. The DC Detector Noise is defined here as the apparent movement of a short, moderately stiff cantilever (Olympus TR800, 100 μ m, $k=0.61$ N/m, or equivalent) not in contact with a surface.
- 5.4. The instrument's AC Detector Noise must be less than 25fm/ $\sqrt{\text{Hz}}$ above 100kHz. This is defined as the noise density above 100 kHz of the apparent motion of a very stiff cantilever (Olympus AC160, 160 μ m, $k = 42$ N/m, or equivalent) not in contact with a surface.
- 5.5. The microscope must have an optical sensing bandwidth of at least DC to 7 MHz.
- 5.6. Laser spot positioning and photo detector centering must be motorized and controlled through software. Photodetector centering must be automated. Illustrative video of this should be submitted as a link to show the ease in operation and automation.

6. System Scanner

- 6.1. The scanner must be closed-loop and independently actuated in X, Y and Z.
- 6.2. The scanner provide XY range of 30 μ m (closed/open loop) or better. The Z range must be at least 5 μ m (closed loop) or better.
- 6.3. X and Y sensor noise must be less than 60pm in a 0.1Hz to 1 kHz BW or better.
- 6.4. Z sensor noise must be less than 50pm in a 0.1Hz to 1 kHz BW or better.
- 6.5. The instrument must be capable of closed-loop atomic-scale resolution.

- 6.6. The microscope must utilize a closed-loop XY scanner that can achieve stable, closed-loop scan speeds of at least 5 mm/s.
- 6.7. The instrument should offer fast scanning scan rate in both unidirectional and bidirectional with closed loop fast scanning rates in XY speeds > 200 Hz in tapping / noncontact mode. The offered system should have a capability to upgrade to enable true video-rate imaging at rates up to 45 frames/second with a scanning speed of more than 1200 lines/second.
- 6.8. Out of plane motion must be <3nm over the closed-loop scan range.

7. System Optics

- 7.1. The instrument must include top-view optics.
- 7.2. The resolution of the optics must be diffraction limited (<1 μ m) and include apochromatic correction.
- 7.3. The optics must have software-controlled LED based Kohler illumination.
- 7.4. The optics must include aperture and field diaphragms.
- 7.5. The minimum field of view is 690 μ m x 920 μ m
- 7.6. The optics must include a CMOS camera with FireWire interface. The software must include digital zoom, pan and capture, as well as balance, shutter speed and binning.

8. Controller and Electronics

- 8.1. The AFM control electronics must provide 100% digital operation.
- 8.2. The electronics must include digitally controlled switches for user-defined signal routing.
- 8.3. The system must provide thermal tunes of the cantilever up to at least 7MHz.
- 8.4. The instrument must allow digital Q-control in the range 2kHz – 20MHz.
- 8.5. The instrument must include software-controlled relays for the X, Y and Z high voltage supplies and the laser power.
- 8.6. The controller must include the following features / specifications:
 - 8.6.1. Floating point DSP running at 80MHz and Dual-core NIOS in FPGA.
 - 8.6.2. Four Field Programmable Gate Arrays running at up to 667MHz.
 - 8.6.3. Two dual frequency quadrature lock-in's at up to 20MHz and one dual-frequency quadrature lock-in at 5MHz.
 - 8.6.4. Sixteen proportional-integral gain controllers
 - 8.6.5. ADC's: 12 or more 16-bit / 18 bit or better configuration
 - 8.6.6. DAC's: 10 or more 24 bit or better configuration including for XY and Z piezo scan signals
 - 8.6.7. The electronics must provide access to all major signals on BNC connectors (e.g., via front- or rear-panel BNC connections), including deflection (A-B), sum (A+B), amplitude, phase, lateral force, X, Y and Z sensors, three user inputs, three user outputs, X, Y and Z piezo drive voltages, and user X, Y and Z modulation voltage inputs compatible with external hardware.
 - 8.6.8. The instrument must include auto-configuration of external hardware and accessories. Device parameters must be stored in non-volatile RAM on the device itself and read into the software when the device is plugged in. This eliminates the need for parameter files.

8.6.9. The instrument must include a user programmable control knob that can be used to fine tune and adjust all scan parameters.

9. Software

- 9.1. Control and analysis must be user-programmable natively in an entirely open-source software programming language.
- 9.2. The system's software must include a one-click software 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.
- 9.3. The data acquisition system must be capable of recording individual image sizes of 8000x8000 pixels or greater.
- 9.4. AFM control software environment must include 3D rendering technology for advanced image display. This feature must allow the user to generate, display and visualize 3D real-time scan images, as well as off-line processing.
- 9.5. The software must allow multiple images and channels of a single scan, such as phase, amplitude, topography, conductivity, etc., to be opened and viewed simultaneously, or overlaid on a primary channel for signal correlation. This must include the ability to overlay 3D images with any image data channel in real-time.
- 9.6. The user must be able to define the graphical user interface layout completely and to drag, enlarge/minimize, and define all imaging windows.
- 9.7. The user must be able to simultaneously perform data analysis using the built-in post-processing software functions, while continuing to monitor (in clear view) the realtime imaging process.
- 9.8. Must include multiple built-in spring constant calibration methods, including the "thermal noise" and "Sader hydrodynamic" methods.
- 9.9. Must include built-in nanolithography and manipulation software.
- 9.10. Must include drift compensation software. Software must allow a region of interest to be tracked in real time to within 1nm of precision while eliminating any scan distortion in the image. Drift compensation must be able to be applied to any imaging, spectroscopy or advanced characterization mode, and in conjunction with sample heating and cooling options.
- 9.11. The instrument software & image pressing software upgrades must be available for the life of the instrument.
- 9.12. Multi frequency techniques: The instrument must be capable of driving the cantilever simultaneously at two or more arbitrarily chosen excitation frequencies in AC (dynamic) mode, while simultaneously collecting and displaying the amplitude and phase signals and images from each of these frequencies, along with the height or Z-sensor data.
- 9.13. The instrument must be capable of tracking the resonance frequency of the cantilever during measurement techniques in which the cantilever is actuated mechanically by the sample. For example, the technique must be demonstrated to track the resonance in either or both Contact Resonance AFM or on-resonance Piezoresponse Force Microscopy.
- 9.14. The software must be able to map the drive amplitude, drive phase, resonance frequency and quality factor of the resonance being tracked by the technique above.

10. System Computer

- 10.1. All the computers for AFM must be imported/factory fitted and tested with pre-loaded software for operating these systems.
- 10.2. The Computer-to-controller communication must be via USB2. This simplifies system set-up and allows easy future upgrade of the system's computer.
- 10.3. The computer operating system must be Windows 7-64bit or better.
- 10.4. Specify detailed computer specification (processor, RAM , graphics card,etc.).

11. Instrument Isolation

- 11.1. The instrument must include an integrated thermally- and acoustically-isolating enclosure. Enclosure must provide at least 20dB of acoustic isolation.
- 11.2. The microscope must have integrated passive vibration isolation.

12. Optional

- 12.1. Conductive AFM
 - 12.2. Quantitative Nano Scale Maps - System configuration must include an imaging mode that is capable of generating quantitative nanoscale maps of storage and loss modulus, and loss tangent (loss modulus divided by storage modulus), at high pixel resolution (at least 1024x1024 pixels). Data capture must occur during normal AC mode imaging of topography at normal scan rates (< 10 minutes per scan). Proposals for techniques that map storage modulus only are insufficient and will be rejected.
13. One year warranty from the date of installation of the equipment with lifetime support. An additional 2 years of warranty of the equipment should be provided in the quotation in year wise format.

A compliance table (see below) must be prepared and submitted along with the technical bid.

Sr. No	Tender specification	Your offered instrument specification	Extent of compliance

2. PRICE BID:

The financial bid indicating (item-wise) price for the item(s) mentioned in the technical bid should be kept in a separate sealed envelope duly superscribed as 'PRICE BID' on the outer cover of the envelop as already detailed above. Price bids of only technically qualified bidders will be opened and they will be intimated the date and time of the opening of price bid at their e-mail ids. Rest of the bidders will stand rejected.

PRICE: Price to be quoted on CIF Kolkata and also FOB basis.

3. BID SECURITY:

- a. An Account payee Demand Draft/Pay Order of any of the Nationalized Banks for Rs. 5,00,000/- (Rupees five lakhs only) drawn in favour of "Indian Association for the Cultivation of Science (State Bank of India, Jadavpur University Branch, A/C No. 11079699211, IFSC:

SBIN000093, MICR Code: 700002048)” is to be furnished by the bidders except those who are registered with the Central Purchase Organizations, National Small Industries Corporation or the concerned Ministry or Department, as Bid Security money or Earnest Money Deposit (EMD). Alternatively, the Bidder shall have the option to furnish the EMD in the format of Bank Guarantee (BG).

b. The Demand Draft for the Bid-Security should have at least 90 (ninety) days validity period of opening of the bids.

c. In case of non-award of the work the Bid Security money would be returned to the unsuccessful Bidders.

4. PERFORMANCE SECURITY:

An Account Payee Demand Draft on any nationalized bank of India of 10% of the order value in the name of “Indian Association for the Cultivation of Science” is to be furnished by the successful bidder as Performance security. Performance security money should remain valid for a period of 60 days beyond the date of completion of all contractual obligations of the supplier including warranty obligations. Bid security money or EMD will be refunded to successful bidder on receipt of the Performance security money.

5. TERMS OF PAYMENT:

Payment will be made through irrevocable Letter of Credit in two instalments. 90% of the money will be released on submission of shipping of documents. Remaining 10% will be released after successful installation of the instrument.

6. GENERAL INSTRUCTIONS:

1. Validity of tender: Tender submitted should remain valid for at least six months from the date of opening the tender. Validity beyond six months from the date of opening of the tender shall be lapsed by mutual consent.

2. The tender should accompany a compliance chart.

3. Incomplete and conditional tenders as well as tenders received after the due date will be summarily rejected without assigning any reasons thereof.

4. At any time prior to the bid due date, IACS may, for any reason, whether at its own initiative or in response to a clarification requested by a prospective bidder during pre-bid meeting, modify the bidding documents. The amendment(s) will be notified on the institute website. Prospective bidders are advised to occasionally to visit the website (www.iacs.res.in/tender) for any amendment.

5. Installation/Demonstration/Application training at site: Installation & user training at IACS, free of cost by the supplier.
6. Service facility: In India, preferably Kolkata, supplier should mention their details of service setup and man powers who are responsible for after sales support. Response time should be within 24 hrs.
7. The model number, make and a printed literature of the product should be submitted positively.
8. Proposed delivery schedule should be mentioned clearly.
9. Manufacturers / exclusive distributors / vendors should have history of supplying this type of instruments to this or other scientific organizations. Availability of a list in this regard would be preferred.
10. Authorized dealership certificate should be provided in case of principal manufacturing company is not quoting directly.
11. Guarantee certificate, users manuals etc. are to be handed over to the user after successful commissioning of the system.
12. In the event of date being declared a closed holiday for purchaser's office, the due date for submission of bids and opening of the technical bids will be the following working day at the appointed time.
13. In case of any dispute, the decision of IACS authority shall be final and binding on the bidders.
14. For any clarification regarding technical specifications, information etc., please send your queries **to Prof. Jyotirmayee Dash** (ocjd@iacs.res.in).
15. The authority of IACS reserves the right to reject any or all of the tenders received without assigning any reason thereof.

Acting Registrar