TENDER REF. NO: NABI/2(036)/18-19/N-PUR

MODIFIED TECHNICAL SPECIFICATIONS AFTER THE PRE-BID MEETING HELD ON 30th May 2018

ATOMIC FORCE MICROSCOPE SPECIFICATIONS

1. Instrument Resolution

The instrument must have demonstrated atomic lattice resolution in AC mode and contact mode imaging. This must be done with the same large scan-range scanner that can also image at least 90µm x 90µm (XY) & 10 µm (Z) in closed loop. This allows large survey scans with the ability to zoom-in to get high resolution images at a region of interest.

2. Instrument Geometry

- The XY & Z scanner should be decoupled. A combination of Flexure / Piezo type scanners would be acceptable as long as they are able to demonstrate the intended capabilities listed here in with all modes of operation.
- Each axis of motion is independently actuated using its own piezo stack and flexure stage. Should have Integrated position sensors in all three axes provide seamless closed loop operation.
- If the system configuration allows a single scanner to be able to achieve large area and small area high resolution images that would be preferred. However, systems which need multiple scanners for large area scanning and separate for high resolution small area scanning the system offered must include such multiple scanners.
- The cantilever holder and the optical lever assembly (laser, optics and detector) must be housed in a way to eliminates artifacts due to relative motion between the optical lever arm and the cantilever during imaging and force measurements.
- Beam used for deflection detection must approach the probe at an angle that is significantly off vertical relative to the sample, such that reflections from the sample surface do not reflect back into the light source or into the detector.
- Sample Scanning / Tip Scanning or such combination would be acceptable.

3. Operating Modes

3.1 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:

- Contact 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
- Piezoresponse Force Microscopy (PFM)
- Tapping Mode

- Quantitative Nano Mechanical Maps – Mechanical properties such as adhesion, elasticity, stiffness, deformation etc.
- Conductive AFM - The system must allow conductive measurements while scanning as well as at user specified locations
- Any other modes, which occur default modes with the quoted system should also be clearly mentioned.

4. Optical Lever Arm: Light Source and Photodetector

- The instrument optical lever arm must use a low coherence light source (for example, a super luminescent diode, SLD or equivalent Laser source) to reduce artifacts from optical interference effects.

5, System Scanner

- The scanner should be compatible with temperature control options.
- The scanner head should be the following minimal specifications
    - XY with closed-loop feedback control
        - Scan range: ≥ 90 × 90 μm (with a single scan head)
        - Noise: ≤ 0.6 nm RMS (closed-loop), ≤ 0.1 nm RMS (open-loop)
        - Demonstrated lattice resolution on mica
    - Z with closed-loop feedback control
        - Scan range: ≥ 10 μm
        - Noise: ≤ 0.25 nm RMS (closed loop)
        - Height noise: ≤ 0.06 nm RMS

X and Y sensor noise must be less than 600pm ADev in a 0.1Hz to 1 kHz BW, with sensor nonlinearity <0.5% at full scan. Scanner noise specifications and representative high-resolution imaging examples must be available for inspection in publicly available brochures, datasheets or websites. The scanner must be compatible with all supplied scan modes and in both air and liquid environments.
System must include a Z scanner with a minimum range of 10 μm that is capable of both open-loop and closed-loop operation. Z sensor noise must be less than 300pm ADev in a 0.1Hz to 1 kHz BW, with sensor Nonlinearity <0.05% at full scan. DC Height Noise must be less than 100pm ADev in a 0.1Hz to 1 kHz BW. Scanner noise specifications and representative high-resolution imaging examples must be available for inspection in publicly available brochures, datasheets or websites. The scanner must be compatible with all supplied scan modes and in both air and liquid environments.

6. Sample Stage

The SPM must have manual X, Y and Z positioning stage for coarse movement.

- The instrument must accommodate samples sizes up to 80mm (dia) and 10mm thick or more. This is an essential requirement to render flexibility to the system for mounting various samples.
- **Sample positioning:** XY sample positioning with travel range > 20 mm and an accuracy of minimum 3 microns.
- **Sample viewing:** Suitable camera system for tip / sample viewing should be included

7.. Controller, Electronics & Software Minimal requirements

System must use at least 24-bit digital-to-analog converters (DACs) in order to generate the XY and Z piezo scan signals. At both 100-micron and 10-nm scan sizes, the corresponding bit

resolution must be sub-Angstrom (<0.1nm). Note that this specification applies to the generation of the scanner drive signals, not the sampling of the scanner position sensors.

- The system must provide thermal tunes of the cantilever up to at least 2 MHz.
- The instrument must allow digital Q-control in the range 2 kHz – 2 MHz.
- The instrument must include software-controlled relays for the X, Y and Z high voltage supplies and the laser power.
- System must be able to support one or more frequency tapping mode operation to measure the amplitude and phase response with dual/triple lock in amplifier.
- Control and analysis must be user-programmable natively in an entirely open-source software programming language.
- The system's software must include a 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.
- Software must include a feature that automatically optimizes the imaging gain and setpoint for tapping mode operation. The feature must use a predictive algorithm such that operation is stable and producing high quality data within the first few scan lines.
- The data acquisition system must be capable of recording individual image sizes of 5000x5000 pixels or greater.
- 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 or 4D real-time scan images, as well as off-line processing.
- 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.
- System must include a feature that automatically calibrates the cantilever sensitivity and spring constant by simply selecting the probe type and clicking a button.
- The AFM supplier to specify that controller and electronics suitable for high resolution imaging f biological samples

8. Instrument Isolation

- The system must include a thermally- and acoustically-isolating enclosure.
- The system must include a vibration isolation table / platform suitable for the system

9. Others

Please clearly list tips provisioned in the standard kit for each mode. For each mode, at least 10 compatible tips (with reflex coating wherever applicable) should be quoted optionally if not included in the kit. For AC mode separate 10 tips for hard and soft samples, 10 bio-sample compatible tips for scanning in air and fluid, for MFM mode separate 10 tips with high and low coerceivity should be quoted optionally if not included in the standard kit

Optional:

These will be purchased only if the price falls within the budget available. However, the vendors must state/certify that the AFM system provided will be compatible with these attachments in case these are purchased separately now or in the future.

1. The AFM should have an option to upgrade and integrate an Inverted Optical Microscope and allow simultaneous AFM and optical measurements (i.e. brightfield, epifluorescence) and optional phase contrast illumination.

2. Cell imaging accessories: The Electrochemical cell assembly should consist of a fluid cell assembly with working and reference electrodes along with an all cantilever holder for use with an inbuild or third party supplied potentiostat.

System should include Heater with a Controller: system should have a sample heart accessory. The stage should ride on the XY scanning stage and should be capable of heating samples up to 8 x 8mm from ambient to 250°C.

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