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TECHNICAL SPECIFICATIONS

Atomic Force Microscope (AFM)

1. Instrument Resolution

1.1. The instrument should achieve atomic, lattice resolution in AC mode and contact mode imaging.
1.2. Large scan-range scanner with up to (XY) 90-100 μm x 90-100 μm in closed loop to allow large survey scan.
1.3. Ability to zoom-in to get high resolution images at a region of interest.

2. Instrument Geometry

2.1. Separate XY scanner and Z scanner.
2.2. Single rigid frame housing cantilever holder and the optical lever assembly (laser, optics, and detector).
2.3. Capable to handle samples sizes > 200mm (dia) and 10mm thick (expandable up to 25 mm). Must come with motorized stages to cover entire sample. Lateral motorized movement of at least 180mm and motorized vertical movement of at least 10mm.
2.4. Include precision encoders for all XYZ axis to provide position accuracy of <2um in XY and <1um in Z
2.5. Must include multi-sample holders and tilting stages
2.6. The AFM system must allow software control and automated cantilever approach using the motorized Z stage.

3. Operating Modes

The microscope should be capable of the following scanning modes:

3.1. Contact Mode
3.2. Two frequency mode
3.3. Resonance tracking mode
3.4. Electric Force Microscopy (EFM) - (Both Dual pass /Lift mode)
3.5. Force Curve Mode
3.6. Force Mapping Mode (Force Volume).
3.7. Force Modulation
3.8. Frequency Modulation
3.9. Fluid imaging: The system should be capable of providing high resolution imaging in liquid environment compatible for various kinds of sample: soft matter, biological cell etc.
3.10. Kelvin Probe Force Microscopy (KPFM)-(Both Dual pass /Lift mode)
3.11. Lateral Force Mode (LFM)
3.12. Magnetic Force Microscopy (MFM) (Both Dual pass /Lift mode)
3.13. Nanolithography/ Nanomanipulation

3.14. Phase Imaging
3.15. Non-Contact (true non-contact mode **preferable**) Tapping Mode
  3.15.1. The Non-Contact mode of AFM system must not touch the sample surface at all during topography imaging in ambient, to save tip operation cost and to secure sample from damage.
  3.15.2. Supplier may prove this capability by using a sample, run the scan for at least 5-10 time using 1 single cantilever tip, and show no degradation in image quality and profile line generated.
3.16. Tapping Mode with Q-control
3.17. Piezoresponse Force Microscopy (PFM)
3.18. Switching Spectroscopy PFM
3.19. Vector PFM
3.20. Vertical PFM
3.21. Lateral PFM
3.22. Imaging on piezo materials in the vertical PFM, lateral PFM, vector PFM and lithography modes.
3.23. High resolution mode for imaging delicate soft samples in both air & liquid environment while maintaining resolution & clarity.
3.24. 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.
3.25. Conductive AFM at sample bias range of -10V to 10V, with flexibility for user-specified waveforms.
3.26. CAFM with output channel gains of 20pA/V - 1uA/V to 1 – 100 nA/V in the range of 4 pA to 10 μA with low noise.
3.27. Scanning Tunneling Microscopy (STM)
3.28. The AFM should have temperature control stage for variable temperature studies. This should be compatible with the system and have the capability to be used in special gaseous environment and for liquid imaging cell. Temperature range of -25 to 250C should be offered.
3.29. The Offered instrument should have a design to hold a variety of cell culture dishes (Petri Dishes) for doing AFM on cell and tissues in liquid with temperature control.
3.30. Should provide all the necessary sample kit (Includes standard calibration grid, MFM, EFM, KPFM, PFM, CAFM and STM sample) and minimum probes for all the above modes/application.
3.31. Should provide all the necessary sample kit (Includes standard calibration grid, MFM, EFM, KPFM, PFM, CAFM and STM sample) and minimum probes for all the above modes/application.

3.32. Mechanical property mapping to provide simultaneous topography, adhesion, modulus, dissipation, deformation etc. with contact forces <50pN at a user selectable ramping frequency is preferred.

4. Optical Lever Arm: Light Source and Photodetector

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

4.2. The instrument should use an appropriate SLD for the optical lever arm.

5. System Scanner

5.1. System should scan the sample in XY and the tip in Z, with independently controlled piezo scanner (tube/flexure design)..

5.2. System should include a closed-loop XY scanner with a range of 90-100 µm

5.3. XY sensor noise <0.2-0.6 nm in imaging band width bandwidth (closed loop).

5.4. System should include a closed loop Z scanner with a range of 10-15 µm. (Extendable up to < /30um will be preferred).

5.5. Z sensor noise <0.25 nm in a 0.1Hz to 1kHz bandwidth (closed loop) or < 0.040 nm in imaging bandwidth.

6. System Noise

6.1. DC Height Noise/Z height must be less than 30pm in a 0.1Hz to 1kHz BW / image <20pm in quiet environments).

7. System Optics

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

8. Controller and Electronics

8.1. Should employ 24-bit digital-to-analog converters (DACs)

8.2. Thermal tunes of the cantilever extending up to 2 MHz.

8.3. Digital Q-control in the range 2 kHz – 2 MHz.

8.4. The system must include software-controlled relays for the X, Y and Z high voltage supplies and the laser power.

8.5. The system should provide auto-configuration of external hardware and accessories without the need for parameter files.

8.6. The AFM controller should come with a high-performance processing unit within built-in lock-in amplifier. (Multiple Independent channels digital lock-in)

9. Software

9.1. Control and analysis must be user-programmable natively in an entirely open-source software programming language.

9.2. The AFM system should have separate software for data analysis and measurement.

9.3. Able to perform multi-tasking with Windows based data acquisition, or equivalent and imaging processing programs at the same time.

9.4. The data acquisition software must have built-in macros, which can be easily loaded and applied for repeating operations, such as moving the XY or the Z stage to a specific location or resetting the operation. Users can edit existing macros or create new ones as needed.

9.5. System software should 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.
9.6. The data acquisition system must be capable of recording individual image sizes of 4K pixels.
9.7. AFM control software environment must include 3D rendering technology for advanced image display.
9.8. Must include drift compensation software.
9.9. 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.
9.10. Software includes a feature that automatically optimizes the imaging gain and setpoint for AC Mode (tapping mode) operation.
9.11. The software must be available free of cost for all users or Minimum 10 licences must be provided for users.

10. Instrument Isolation

10.1. The system must include an active vibration isolation table suitable for the system performance and specifications.

11. Desktops, UPS: Two high end Desktop PCs for extended screen, and UPS to provide backup for 15 minutes should be provided.

12. Acceptance criteria: All the parameters and specifications quoted above should be demonstrated on the instrument after installation. Appropriate training for full operation of the system should be given at least twice a year during the period of warranty.

13. Warranty*:* The entire system should carry a comprehensive warranty for 3 years.