



PR No. 1000030053

Rfx No. 6100001282

Technical Specifications of Atomic Force Microscopy

1. AFM System

- i. Scanner, camera, micrometer stage, active ant vibration table and air flow protection integrated in a single device.
- ii. Easy accommodation of the largest variety of different samples and sample holders up to 100mm in diameter and 10 mm in height.
- iii. Integrated manual sample positioning with 20 mm x 20 mm travel in XY. The AFM must have a xyz tip-scanning configuration.
- iv. The AFM must include both top and side view optics for sample viewing. Should have the option to rescan the disturbed line in image during live imaging.
- v. Should be capable of accommodating self-aligned cantilevers with alignment grooves to guarantee that laser is also automatically self-aligned on the cantilever back; manual laser adjustment must be possible for grooveless and special cantilevers.
- vi. Integrated active antivibration table (min. 25 dB (94.0%) at 5 Hz, 40 dB (99.0%) above 10 Hz) with detection of non-adjustable external vibrations and consequent automatic re-measurement of the current scan line
- vii. Microsoft Windows compatible and freely available acquisition and analysis software with software updates included for the product lifetime.
- viii. Capability of integrating a single objective digital inverted microscope for combined optical experiments, with fluorescence option for optional upgrade.

2. Mode of Operation

The system must include the following scanning modes:

- i. AFM Contact Mode
- ii. AFM Tapping Mode
- iii. Lateral Force Microscopy
- iv. Phase Imaging
- v. Force Modulation Microscopy
- vi. Force Distance (F-D) Spectroscopy
- vii. Lithography
- viii. Liquid imaging

3. Scanner

- i. Flexure-based XY scanner and decoupled piezo-based Z-scanner. Piezo tube scanners are not acceptable.
- ii. Must have possibility to have an ample choice of detachable cantilever holders with kinematic mount to accommodate standard commercially available cantilevers with alignment grooves.
- iii. AFM laser operating at a wavelength between 645 and 655 nm. The scanner must have a XY axis scanning range $\geq 100 \mu\text{m}$, and Z axis scanning range $\geq 12 \mu\text{m}$. Z-measurement noise level $\leq 40 \text{ pm}$ (RMS, dynamic mode in air)
- iv. Optical Z position sensor with a noise level $\leq 180 \text{ pm}$.



INDIAN INSTITUTE OF TECHNOLOGY BOMBAY
MATERIALS MANAGEMENT DIVISION
Powai, Mumbai - 400076

4. System Optics

- i. AFM scanning cantilever/probe optical surface should be viewable on axis in real time via DirectOptical Video Access by CCD.
- ii. The resolution of the optics must be 2 μm or better.
- iii. The AFM must include top-view optics with motorized focus & digital zoom. Systems having both top view and side view camera with motorized focus and digital zoom will be preferred.
- iv. The optics must have software-controlled white LED illumination.
- v. The optics must include a 5-Megapixel or higher camera, and software to display and store the optical image from within the AFM software.

5. System Controller

- i. All digital signal processing for maximum freedom of operations. Very sensitive 24 Bit ADC/DAC for Zoom-In and precise acquisition. 16 bit controllers are strictly not acceptable.
- ii. Highest quality of analog signal handling for minimum electronic noise. 32Bit CPU and multitasking operating system for parallel operations.
- iii. X/Y/Z-Axis Scan & Position Controller 3 x 24Bit DAC, 200kHz. X/Y/Z-Axis Position Measurement 3 x 24Bit ADC, 200kHz Excitation & Modulation Outputs 4 x 16Bit DAC, 20MHz Analog signal input bandwidth DC to 5MHz Main Input Signal capturing 2 x 16Bit ADC, 20MHz, 2 x 24Bit ADC, 200kHz
- iv. Additional User Signal Outputs 3 x 24Bit DAC, 200kHz
- v. Additional User Signal Inputs 3 x 24Bit ADC, 200kHz
- vi. Additional Monitor Signal Outputs 2 x 24Bit ADC, 200kHz
- vii. Digital Synchronization 2 x Digital Out, 2 x Digital In, 2 x I2C Bus.
- viii. FPGA Module & Embedded Processor ALTERA FPGA, 32Bit NIOS-CPU, 80MHz 256MB RAM, Multitasking OS Communication USB 2.0 Hi-Speed to PC System synchronization 10MHz internal quarts or external clock Power 90-240 V AC, 70W, 50/60H

6. Detector

- i. High-speed, low-noise 4-quadrant photodiode detector; Choice between red laser and near infrared SLD; Laser on/off through software.

7. Computer/UPS

- i. Latest branded PC with windows 10 operating system, 500GB hard drive, 8GB RAM, DVD writer, mouse, keyboard, 24 inch Monitor and licensed software for the operation of the instrument.
- ii. Software must be a single package for all modes and attachments with no need for additional software programs.
- iii. Software package must include both image acquisition and data processing software in one package with no need for different programs operation.
- iv. $\frac{1}{2}$ hour back up online UPS must be provided.



INDIAN INSTITUTE OF TECHNOLOGY BOMBAY
MATERIALS MANAGEMENT DIVISION
Powai, Mumbai - 400076

8. Image Analysis Software

- i. Image Display: Dual Imaging Window for Scan and Retrace image. Sample Navigator: Assistant for localized zooming w.r.t. a large area scan.
- ii. Analysis Functions: Line (Single line profile) Extraction, Localized Zooming, Roughness Display, Measure length & angles on the images, 2D Fast Fourier, Transformation etc.
- iii. Image Processing Tool: Spatial and Fourier Low- Pass Filtering, Background Subtraction, Histogram Equalization, Zooming, Contrast, Slope Correction etc.

9. Others

- i. Please specify details of any other options which is not specified here but are part of the system without any additional cost.

10. Power Supply

- i. The system should be compatible with the Indian power supply e.g., 90–240 V AC, 70 W, 50/60Hz.

11. Installation and Training

- i. The system must be installed, and demonstrated by factory trained engineers on our site free of charge.
- ii. Comprehensive on-site training required to our satisfaction.

12. Warranty and Support

- i. One year comprehensive warranty must be included along with the bid/offer separately. Warranty should start from date of installation.

13. Future upgradation capabilities

- i. The system must be capable of further upgradation as shown below with additional costs Electrical force microscopy Magnetic Force Microscopy (MFM).
- ii. Variable Magnetic Field Application: System must be capable of supporting an accessory that allows application for Variable in-plane and out-of-plane magnetic fields, with field strength controlled from within the software.
- iii. The in-plane magnetic field should range from at least +/-7,000G and the out-of- plane field strength should range from at least +/- 1200 Gauss.
- iv. The accessory maybe purchased in future as upgradation. 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.
- v. High Voltage Module for PFM studies with range up to +/- 100 V or higher. System must include an accessory that enables application of a variable high voltage (+/- 100 V) bias



INDIAN INSTITUTE OF TECHNOLOGY BOMBAY
MATERIALS MANAGEMENT DIVISION
Powai, Mumbai - 400076

- between the tip and sample.
- vi. Voltage must be software controlled and capable of high frequency (>100kHz) operation.
 - vii. Accessory must include features and training to help ensure safe operation. Dual frequency resonance tracking or equivalent for PFM Heterodyne Kelvin probe microscopy Contact resonance imaging Cooling/heating from -35 o C to 180 o C
 - viii. Environmental control for gas purging and humidity control Cantilever based microfluidic system for injection, Traditional glass micropipettes are not acceptable.
- A. Must include the proper control system
 - B. Pressure range -800 to 1000 mbar
 - C. Pressure resolution 0.5mbar or better
 - D. Transient response time 1s or better
 - E. Must include at least 20 different probes and barcode reader to read tip type and parameters Should allow the recording of time-lapse mass measurements in physiological conditions, while simultaneously conducting fluorescence and/or differential interference contrast microscopy (DIC).