**Department of Applied Mechanics**
**Indian Institute of Technology Delhi**
**28th November, 2012**

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**NIQ for Item 1: Atomic Force Microscope**
**Item 2: Instrumented Nanoindenter**

**Sealed quotations in two bids (Technical and commercial in separate sealed envelopes) are invited for Item 1 and Item 2 respectively. Same vendor if bidding for both Items 1 and 2,must include two separate envelopes containing (Technical and commercial bid) for Item 1 and Item 2, superscripted "Quotation for AFM" and "Quotation for NI" respectively. Please include a detailed compliance statement with explanation.**

# Item 1: Specifications for Atomic Force Microscope

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| 1 | **Operating Modes in Liquid and Air**<br><br>1.1 Imaging Modes<br>Contact Mode, Non Contact Mode, AC(Dynamic Force/Intermittent Contact), Constant Force, Constant height, phase, amplitude and force modulation imaging (FMM), In liquid Imaging (e.g live cell imaging).<br><br>1.3 Non imaging modes<br>Force-distance, Force-volume and **other force spectroscopy modes**, Nanoindentation, Nanolithography and Nanomanipulation.<br><br>* The instrument should have easy upgradability option (in all aspects, e.g modes, hardware, software etc) in future. | **Explanation of the technical specifications**<br><br>1.1 Please include all the modes which will **come with your default system** and meeting our requirement mentioned on the left. Also quote additional advanced modes as optional if your system does not provide it as default. 1.2 We are looking for a system with maximum flexibility to upgrade in future. |
| 2 | **Scanners**<br><br>2.1 Advanced closed loop control for lowest settling time for prevention of overshoot and ringing.<br>2.2 Z axis should be mechanically de-coupled from XY scanner.<br>2.3 3 axis capacitive position sensor for closed loop operation.<br>2.4 XY scan range: 90 um X 90 um or higher<br>Resolution<0.5 nm, XY non-linearity<0.5%<br>2.5Single scanner for various XY scan ranges. (including atomic resolution images)<br>2.6 Z scan range: 15 um or higher<br>Z noise: <0.05 nm and sensor non-linearity<0.05%<br>Include <u>extended z-stage ≥ 30 um</u>.<br>2.7 Cantilever deflection measurement: Noise<0.02 nm, sensor nonlinearity<0.5%, bandwidth>2 MHz<br>2.8 Low coherence light source is must.<br>2.9 Low thermal drift<1.5 nm/min/$^0$C<br>2.10 Scan head must be calibrated with NIST standard.<br>2.11 AFM must be capable of scanning atomic resolution images on atomic lattice structures such as Mica (in air or buffered solution, **Must be demonstratable**).<br>2.12 The scanner should be designed for easy integration with optical microscopes, supporting fluorescence, confocal laser scanning microscopy, TIRF, Raman and others.<br>2.13 Optical filters for elimination of cross-talk with fluorescence illumination and low coherence light must be ensured.<br>2.14 In-situ switch from liquid to air operation mode is necessary.<br>2.15 Physical access to cantilever from all sides (e.g micropipette) is must.<br>2.16 Cantilever region should be visible from sides.<br>2.17 Should have mechanism for "**<u>simple</u>**" in-situ cantilever and photo diode alignment. | 2.1 Clearly mention the resolution, nonlinearity and scan heights in your system.<br><br>2.7 Clearly state the **numerical values in the compliance sheet**. |
| 3 | **Specimen Stage**<br><br>3.1 Manual/motorized XY stage movement (~ 20 mm X 20 mm) before | |

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| | engagement.<br>3.2 **Automatic approach** and tilt correction is absolutely essential.<br>3.3 Step resolution~ 2 um or better.<br>3.4 Sample size: System should be able to accommodate large as well as small sample. Max sample size should be 80mm X 30 mm/Max Dia: 80 mm or bigger.<br>3.5 Sample height up to 10 mm or higher<br>Sample weight up to 500 g or more. | |
| 4 | **Electronics**<br><br>4.1 XY and Z control electronics: Closed loop feedback scan in all three axes.<br>4.2 The data acquisition sampling rate >50 MHz<br>4.3 High performance DSP based control electronics with Field Programmable Gate Array (FPGA) platform. Scripting interface with controller is necessary. Processor speed $\geq$ 80 MHz<br>4.4 All the ADC and DAC channels ≥ 16 bits<br>4.5 DSP board should be inside the controller, not in the computer. Computer to controller communication/data transfer speed≥100 Mbps.<br>4.6 Should have active Q-control.<br>4.7 Digital Q control of the cantilever's quality factor, should allow simultaneous collection of 8 data channels or more simultaneously, should provide thermal tuning of cantilevers to 2 MHz in air or fluid to determine cantilever's resonant frequency and spring constant (**demonstratable**).<br>4.8 System should provide at-least 3 (or equivalent numbers of) fully digital lock in amplifiers, with easy user access and should be capable of applying up to ±10V (or more) bias to the AFM tip or sample. It must provide real time adjustment to all scanning parameters – scan rate, scan size, scan offset, gains and others.<br>4.9 Should include software controllable digital filters.<br>4.10 Should support use of micro-actuated cantilevers for fast scanning (≥ 10 Hz).<br>4.11 Fast, single cable USB based computer-to-computer communication should be available, electrical noise:< 1 pA(p-p), Bandwidth:~500 kHz<br>4.12 Access to all major signals on BNC connectors through either controller front panel or by a break-out box.<br>4.13 Image resolution must be greater than 5kx5k<br>4.14 All other necessary additions for high speed data capture, smooth I/O operation. | |
| 5 | **Software**<br><br>5.1Fully functional software for data acquisition and data analysis for Windows (XP, VISTA or 8) or Linux operating system.<br>5.2Thumbnail view should be available to allow searching, sorting and viewing AFM-specific data files to work with other software.<br>5.3 Scientific publication-quality graphics and layout capabilities and movie making facilities should be available within the control and analysis software environment.<br>5.4 Generation, display, and visualization of 3D images in real-time (during scan as well as off-line processing).<br>5.5 Command line interface for low level access is necessary.<br>5.6 Advanced **quantitative (mechanical) data processing capability** from AFM scan results in air/liquid should be included.<br>5.7The system should be capable of perfectly "overlaying" AFM scan image and optical image with sub diffraction limit precision.<br>5.8 The system should be able to produce Sub-nm resolution image in liquid.<br>5.9 Automatic calibration of optical image is necessary. | |
| 6 | **Viewing Optics**<br><br>**Inverted Microscope for transparent (e.g bio) sample**<br>6.1Please quote the **Olympus IX71** (or equivalent model with same functionality from Zeiss/Leica/Nikon) model with Phase/Metal Halide Fluorescence illuminator. For detailed specification, see the attached configuration.<br>6.2 Microscope frame: Microscope stand with ON/OFF switch, sextuple revolving nosepiece, magnification changer (1x and 1.6x) and 2-step light path | |

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| | selector(observation: left side port=100:0,20:80),corresponded to near infrared(700-1000 nm),relay lens,CA1.6X,prism,dust proof glass-AW multi coated.<br>6.3 C-Mount adapter as video port adapter<br>6.4 Observation tube: Binocular<br>6.5 Eyepiece: Widefield FN22, Widefield FN22 focusable.<br>6.6 Objective 10xPh: U plan semi apochromat phase objective 10x/03,WD 10<br>6.7 Objective 40xPh: LD plan semi apochromat phase objective 40X, NA 0.6,WD 3.0-4.2 (cc. 0-2)<br>6.8 Objective 60X: Plan apochromat objective 60x/1.42, wd 0.15 (spring, oil).<br>Fluorescence Attachment: Fluorescence illuminator (340 nm applicable) with filter slider (32 mm dia.), including UV light protection plate.<br>6.9 Florescence Cube Cassette: Six position Fluorescence Turret for Fluorescence filter cubes.<br>6.10 Filter Cube Assembly for DAPI.<br>6.11 Filter Cube Assembly for FITC etc<br>6.12 Filter cube Assembly for TRITC etc<br>6.13 BF Cube<br>6.14 X-Cite Metal Halide Fluorescence illuminator.<br><br>**Color CCD video camera with stand/Top view optics for opaque sample**<br>6.12 For real time opaque sample viewing. Please include a separate base, so that opaque sample can be analyzed outside the Inverted microscope platform if necessary.<br>6.13 Manual zoom ≥ 12x<br>6.14 Resolution 4 um or better.<br>6.15 Digital zoom: Upto 100 x or more. | |
| 7 | **Accessories**<br>7.1 A compatible active vibration isolation for atomic scale imaging.<br>7.2 The system should include acoustic enclosure which should provide acoustic noise isolation better than 20 dB.<br>7.3 Proper mounting set ups for active vibration isolation/acoustic chambers.<br>**Liquid cell imaging**<br>7.3 A sealed environmental chamber (perfusion chamber) with multiple ports for liquid or gas exchange.<br>7.4Disposable, easily cleanable small volume fluid or gas cell.<br>7.5Temperature controlled (10$^{o}$C to 60 $^{o}$C or better range) in liquid imaging option.<br><br>**Cantilevers**<br>7.6 Atleast10 cantilevers should be provided for each available imaging and non-imaging modes. For advanced optional modes, please quote cantilever prices separately.<br>7.7 Proper cantilever holders for scan in air/liquid environment must be included. | |
| 8 | **Nanoindentation**<br>8.1Cantilever based nanoindentation feature should be included.<br>8.2 If quoting <u>instrumented indentation</u>, kindly include it as <u>optional item</u>. | |
| 9 | **Optional**<br>9.1 C-AFM Modes, Piezoforce Microscopy, STM, Electrochemical Force Microscopy, Kelvin Force Microscopy.<br>9.2 Additional hardware/software options for cell-cell adhesion studies.<br>9.3 Magnetic field cantilever holder for magnetic field perpendicular to sample surface surrounding the cantilever, and suitable accessories for it.<br>9.4 Advanced features(e.g. Microfludics+AFM etc) for single cell mechanics or cell population level studies.<br>9.5 Sample Heating/Cooling Stage: The sample heating/cooling option (-25 $^{o}$C to 100$^{o}$C) with 0.1 $^{o}$C temperature stabilization.<br>9.6 Customized ( hollow/tipless/microchanneled) cantilever for delivery/nano-injection (e.g drug etc) at intra-cellular level. | 9.1 Please quote the price separately for each modes if they are not already part of the default system.<br>9.2 We plan to integrate Magnetic twisting (twisting of nanoparticles on soft cell like samples) cytometry with AFM scan. |
| 10 | **Warranty**<br>3 Years | |

# Item 2: Specifications for Instrumented Nanoindenter

| State of art nanoindenter capable of performing quantitative testing for characterization of materials at nano scale level. The device should be capable of conducting various tests such as evaluation of mechanical properties, hardness, scratch etc. | |
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| Device | Description |
| Nanoindentation device | The instrument should be capable of performing **hardness and nano-scratch testing**<br><br>Basic module is required for the measurement of force and displacement.<br><br>The instrument should contain:<br><br>**Maximum load:** 500 mN<br>**Load resolution:**40nN or better<br>**Maximum displacement:** 200 µm or better<br>**Displacement resolution:** 0.04 nm or better |
| Sample stage and holder | Positioning accuracy = 1µm or better, step resolution 0.25 µm or better, motorized sample manipulation (X and Y table), sample stage, holder, accessories |
| Indenter | The instrument should have pre-mounted Berkovich diamond tip indenter of 100 µm diameter, conical indenter for scratch test with 90° cone angle and 50 µm tip radius, low thermal drift of 0.15 nm/s or better |
| Materials for calibration | Fused quartz for hardness calibration. |
| Anti-vibration table | Integrated active anti-vibration table for the complete instrument platform, environmental isolation system |
| Microscope | Magnifications upto2000 X or better, standard high resolution color video camera (CCD camera), scanning probe microcopy (SPM) imaging |
| Electronics and computer package | External communication connectivity USB 2.0 or better, computer workstation with monitors, electronic control module, full software package for data acquisition and analysis , user friendly software that allow for easy calibration/operation/data acquisition at high rates and data analysis |
| On-site Installation & Basic Training | System installation, verification of performance, hardware & software training, instrument calibration |
| Warranty | 3 Years |
| **Include the following modules as <u>optional items</u>.**<br>**- Nano-Dynamic mechanical analysis (DMA)**<br>**- Heating/cooling stage option (for high temperature measurement)**<br>**-Cell mechanics package.** | |

**General condition**: 1. The vendor should have sold the quoted instruments in India before, and should be able to arrange for "on site" demonstration on request. Purchase committee needs the list of the references where the instruments have been sold.
2. The purchase committee will also give priority to after sell service record of the vendor.
3. Deposit EMD (Earnest Money) amount of **2.5 Lakhs each** for Item1 and Item 2 through demand draft drawn in favor of "**The registrar, IIT Delhi**".

**General guidelines**:
1. Please quote the above item on **FOB** (Freight on Board) mode as per the IIT Delhi policy.
2. If the above system is a proprietary item then a Proprietary Certificate should be enclosed.
3. Letter from the manufacturer specifically to quote for this tender is to be attached for authenticity of dealership/ agency and the dealer should be authorized service provider.
4. Vendor should get a fresh certificate directly from their product principal's clearly mentioning about three years warranty of the equipment to be delivered from the date of installation.
5. The lowest quotation however does not depend upon the warranty period and AMC price beyond 3 years should be mentioned separately.
6. The lowest quotation does not depend on the optional items included.
7. The validity of the quotation should be at-least three months, the vendors will do the **installation, training and demonstration in the IIT Delhi premises without additional charges**.
8. Taxes, terms and conditions should be clearly mentioned.
9. Specifications form should be similar to the given specification sheet.
10.Compliance statement for the required specification should be attached.
11.Payment terms and conditions should be clearly mentioned. No advance payment is encouraged by IIT Delhi.
12. Firm MUST provide a compliance statement vis-à-vis specifications in a "tabular form" clearly stating the compliance (please mention numerical data wherever necessary) and giving justification, if any supported by technical literature with clear reference of page number, paragraph or lines. This statement must be signed, with the company seal, by the tendered for its authenticity and acceptance that any incorrect or ambiguous information found submitted will result in disqualification of the tender. The quotation should be complete in all respects. (as per IIT-Delhi rules).
13. The bidder must be a reputed Original Equipment Manufacturer (OEM) or an authorized local agent.
14. Further, if the Indian agent quotes for the above mentioned item on behalf of the foreign supplier, then the Indian agent should be enlisted with the department of Expenditure, Ministry of Finance (Government of India). Copy of the supporting documents has to be enclosed with the quotation. Further, in the letter it must be clearly stated from the principles that the bidder is an authorized agent.
15. Vendor should be able to arrange for onsite demonstratation of technical specifications on request.
16. The products will be used for educational purposes. Any applicable academic institution discounts should be offered and stated clearly.

**The Institute/ purchase committee has the right to accept or reject any bid or all quotations without assigning any reason whatsoever.**

**Dr. Rajesh Prosad,**
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**Department of Applied Mechanics,**
**IIT-Delhi, Hauz Khas, New Delhi 110016**

**The quotations should reach the Department of Applied Mechanics , IIT-Delhi by 1200 hrs 24th December**