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

Technical specifications for Optical Tweezers Facility

RFx No. 6100000868 (Reference No. 1000021930)

---

1. The system should consist of a dual-beam optical tweezers with option of magnetic twisters fully integrated with multimode imaging system (with multiple possible imaging modes such as confocal fluorescence/fluorescence/TIRF/Widefield/IRM/DIC etc.), optical table with vibration isolation, along with required computers, electronics, software, accessories required for operation, data collection and data analysis. All technical specifications of the multimode imaging system and optical table with vibration isolation being offered by bidder should be clearly stated without any ambiguity. Offered multimode imaging system should be compatible with electronics, software, accessories required for operation, data collection and data analysis of the optical tweezers facility.

Required technical specifications for multimodal imaging system are given below:

Fully motorized and computer-controlled inverted fluorescence research microscope with multiple port design:

- Optics for bright field, fluorescence and DIC observation
- It is preferred to have a Motorized universal condenser turret with NA 0.55 or better; motorized 6 (or better) position objective turret with 4 or more DIC slots; motorized filter turret with at least 6 positions for band pass fluorescent filters for sample visualization. Band pass filters for GFP/FITC, DAPI, TRITC/ Rhodamine/ cy3 should be quoted.
- Binocular tube for sample visualization. Compatible C mount adapter for multiple ports (at least two for simultaneous attachment of two cameras). CMOS USB 3.0 b/w camera for C-mount
- The ports should be camera-ready with all required optics for epifluorescence/bright-field imaging/DIC imaging. Further, it should be possible to send 100% light to each port
- Built-in motorized z-focus drive capable of step size of 10 nm or better without encoder, and step size of 20 nm or better with encoder.
- High power LED for diascopic illumination. Epifluorescence adaptor with a remote-controlled/computer-controlled fluorescence excitation source/mercury light source. Extra lamps (one for each type) should be quoted for both.
- Plano apochromatic spring-loaded objectives: 10x/0.45 or better NA (air), 20x/0.75 or better NA (air), 40x/0.75or better (air), 60x/1.40NA or better (oil immersion), 100x

1.45NA or better (oil immersion) with complete DIC accessories for all objectives. All objectives should be corrected for UV, visible and IR wavelengths.

- High resolution plano apochromatic confocal and multiphoton grade spring-loaded objectives: 60x/1.27 or better NA (water immersion) suitable for bright field imaging, and 60x/1.27 or better NA (oil immersion) for super-resolution imaging.
- Additional 40X (NA 1.1 or better) water-immersion confocal grade apochromatic objective dedicated for FCS/FCCS should be quoted.
- Additional 60X (NA 1.49 or better) oil-immersion and 100X (NA 1.49 or better) oil-immersion confocal grade apochromatic objective dedicated for TIRF should be quoted.

Motorized XYZ Stage

- Motorized and programmable X-Y specimen scanning stage including controller with universal sample holder for slides, Petri dish and multi-well plate.
- XY motorized stage with 15x15 mm movement, High precision XY stage with minimum 100x100 micron range of motion with 10 nm or less resolution in X-Y with required controllers.
- Piezo/Galvo Z-stage (mountable on the X-Y stage) with minimum 100 micron range of motion, 10 nm or less resolution in Z, 5 nm repeatability, 10 nm step size, and 0.5 to 12.5 mm/s speed range.
- Hardware-enabled auto-Z drift correction focus drift compensation device for long-term time-lapse imaging applications

Temperature and CO_2-controlled incubation stage for live cell imaging

- Programmable/software-controlled fully automatic on-stage incubation system with temperature, 95% humidity and 5% CO_2 control (capable of operating with 100% CO_2 gas supply). Large incubation chamber for temperature control and a smaller chamber for CO_2 control. Active CO_2 and temperature control with sensors. The chambers should be compatible with operation with the piezo/galvo stage.
- The environment chamber and stage should accommodate standard chamber slides, slides with cover-glass, multiple round bottom cover-glass dishes of various sizes and multi-well plates. The system should support live cell imaging up to 72 hours.

Sample Holder for optical Tweezer applications

- Sample holder for slides, Petri dish or custom fluid cells
- Motorized XY sample positioning (minimum 15x15mm)
- XYZ Piezo nanopositioning sample scanner. 100 micron x100 micron x100 micron
- Multichannel laminar flow cell with temperature Control
- Temperature range from room temperature 42°C
- Sealed dual cover slip design

- Up to 5 parallel flow channels fed through tube connectors
- Starter kit for laminar flow cell
- Dual syringe pump for fluid flow
- Fully integrated software control

High-performance active vibration isolation optical table

- Active 1800 mm x 1200 mm floating anti-vibration optical table with minimum thickness 305 mm for the complete confocal and optical tweezers system with at least two active and two precision tuned passive dampers
- Working surface 4.8 mm thick 400 series ferromagnetic stainless steel with Surface Flatness± 0.1 mm over 600 mm square, Mounting HolesM6, Mounting Hole Pattern25 mm grid
- Equipped with Pneumatic Vibration Isolator with Automatic Re-leveling feature of minimum 28 in. Height along with required compatible accessories such as air-compressor etc.

Lasers (including control electronics, shutter and manipulator for fiber output.)

- Diode laser with 488 nm
- DPSS laser with 561 nm
- Diode laser with 640 nm
- It is also preferred to have a Diode laser with 405 nm
- A maximum deviation of +/- 2 nm from above-mentioned wavelength is acceptable.
- Output power at the fiber end for each laser: 15 mW or better with built-in Acousto-Optic Tunable Filter (AOTF)
- All visible lasers should be connected to the scan head through fibre optic cable and should be computer-controlled through AOTF for fast laser switching and attenuation in synchronization with the laser scanner.

Laser scan head

- Confocal laser point scanning unit should be quoted. It should be capable of line-scanning in 2D (space-time) as well.
- Scanner should have laser ports to connect to lasers and should have either low angle of incidence dichroic for high efficient excitation laser suppression and for applications like FCS/FCCS. Standard filter for quoted wavelengths i.e. 405, 488, 561, 640 (with +/- 2 nm deviation as mentioned above)
- Motorised and computer-controlled continuously-variable confocal pinhole with software control.
- Scanner: galvano scanners, Pixel size: at least 4096 x 4096 pixels, 2 fps or better (512 x 512 pixels, bi-direction, 1x zoom)

- Zoom: ~1-1000x continuously variable
- Scan mode: X-Y, X-T, X-Z, XY rotation, Free line, Line-Z.
- The laser scanner should have dual scan capability of fast volumetric regions bleaching/activation/ablation & normal scan for Imaging to conduct experiments like FRAP, FRET, FLIP, photo activation/conversion.
- It should also be capable of real ROI-based scanning for fast time-lapse experiments.

Detectors

The detection unit should have dual detection capability with intensity-based confocal imaging as well as spectral confocal imaging.

- Should have minimum 3 detectors (of which at least 2 should be highly sensitive GaAsP/HyD) or a 32-channel high sensitive spectral detector or equivalent with minimum 45% quantum efficiency. The system should be capable of simultaneous detection and separation of at least 3 fluorophores with built-in confocal detectors (at least 2 fluorophore imaging with high sensitive GaAsP/HyD). All the detectors should be actively cooled for best SNR image over extended period of time with excellent dynamic range for low light imaging applications.
- It is preferred to have minimum 2-channel (violet/green, green/red and CFP/YFP combinations) NDD GaAsP/APD(SPAD)/HyD for multiphoton detection in reflected fluorescence light path.
- The spectral dispersion of the emission light should be of latest technology with high efficient separation. The system should be capable of online separation of autofluorescence and bleed through.
- Capability for lambda-scan should be quoted.

The system should be capable of recording emission spectra with minimum spectral resolution of 5nm of better.

- CCD/EMCCD camera from a leading brand compatible with confocal microscope should be quoted.

FCS/FCCS Imaging System:

System should be capable of performing FCS/FCCS (auto and cross correlation) with high sensitive detectors. This can be quoted as either card/RICS-based or dual-channel GaAsP/APD-based. There should be minimum after-pulsing for the complete visible range in live cells and solutions for a wide range of dyes and proteins like FITC, R6G, GFP, Cy3, Cy5, R6G/Cy3, GFP/RFP, Cy3/Cy5, CFP/YFP etc. All laser lines for confocal imaging should be capable of working in FCS/FCCS mode. Measurement software for auto and cross-correlation capabilities should be quoted. Additional software modules for diffusion with models for rotational, flow, free as well as anomalous translational diffusion should be provided. Software for enhanced fitting with algorithms for global and interactive fit. Software for photon

counting histogram should also be quoted.
Computer with monitor, keyboard and mouse. The below specifications are the minimum requirements. Windows 10 Pro 64bit, CPU-Intel Xeon W-2125 (4.0GHz, quad core, 8.25 MB, 2666 MHz) or higher, RAM- 64GB or higher, HDD-1st HP Z Turbo G2 512GB PCIe M.2 SSD or better, 2nd SATA HDD 2TB or better, Optical Drive-Super Multi drive, up to x16 speed or higher, Extension slot-Two PCI Express 3.0 (x16) slots (one slot to be used for graphics), One PCI Express 3.0 (x8) slot, Two PCI Express 2.0 (x4) slot, LAN port 10/100/1000 Network/Interface x 2 (for connection to controller, for connection to external LAN), High resolution large LCD/LED screen with 30" diagonal, 2560x1600 pixel resolution, dual monitor configuration recommended. Computer should be from a reputed company factory and not of assembled type.

Dual-Beam Optical Tweezers:

2. The system should be optimized for ultra-sensitive single-molecule experiments, trapping and tracking of nano-particles.

3.Laser module:Continuous wave (no time-sharing) tweezers, wavelength of 1064 nm, 3W laser power or higher, lasers with different output power preferred

4. One of two beams with adjustable power distribution preferred.

5. Force detection, independent on both optical traps with stability preferred.

6. Steering of beams using advanced piezo mirror or AOD. System with AOD option for beam steering preferred. Technical specification piezo mirror/AOD should be clearly stated. It is preferred that two independent steering units should be configured at least One with standard Piezo and one with AOD to provide maximum flexibility. De-Multiplexing of detector signals for up to 8 traps for quasi simultaneous force measurements with AODs. Decoupled two-channel detection [XY (quadrant photodiode) and Z (photodiode)] for optimized Z sensitivity. Non-linearity of trap stiffness and sensitivity <5% over the entire field of view. 3.5 MHz bandwidth InGaAs photodiodes optimal for use with 1064 nm laser source. Motorized discrete (4 step) dynamic range adjustment

7. The system should include a force-detection unit, allowing force measurements. System with lowest force resolution preferred. Minimum force resolution to be clearly stated.

8. Fully integrated software suite for system operation with possibility of scripting

Note: Supply and integration of a Magnetic Twister to apply torque and rotate magnetically sensitive particles is desirable. It should be able generate homogeneous magnetic field of few hundred mT at distance of 1mm. Magnetic twister should provide precise rotational control with

accuracy of at least 4 degree using stepper motors and should have integrated software control. Magnetic twister should not disturb bright field and fluorescence imaging. Price of magnetic twister if offered by bidder should be separately quoted.

9. All possible applications of offered system should be clearly stated. Cost should include Installation/commission and initial operator training. On-site application training and application start-up kits/consumables must be supplied by bidder.

10. Cost should include 3 year on-site comprehensive warranty.

11. Cost of Annual maintenance contract (AMC) for additional 2 years subsequent to the warranty period should be quoted. Bidder should also include full description of services to be provided during the AMC period.

Bidders should also enclose:

a. List of similar equipment installations made in India or abroad during last 5 years

b. Internationally published papers using the offered model should be provided. Enclose complete citations of the published papers.