



## National Institute of Technology Durgapur

Centre of Excellence in Advanced Materials, Mahatma Gandhi Avenue, Durgapur -  
713209, West Bengal

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### AMENDMENT OF SPECIFICATIONS

Ref: Tender ref. IFB No.: NITD/COE/2014/NCB/01 dated 24-03-2014

Date: April 11, 2014

**The following amended specifications have been resolved in the pre-bid meeting held on April 4, 2014 at Department of Physics for procurement of the below mentioned items for the Centre of Excellence in Advanced Materials under TEQIP-II. All other terms and conditions remain as advertised in the original tender document (Ref. IFB No.: NITD/COE/2014/NCB/01) dated 24-03-2014, and may be found at NIT Durgapur homepage.**

1. BID REFERENCE: **TEQIP-II/NITD/379 (Scanning Electron Microscope)**
2. BID REFERENCE: **TEQIP-II/NITD/380 (Raman Spectrometer)**
3. BID REFERENCE: **TEQIP-II/NITD/382 (Atomic Force Microscope)**
4. BID REFERENCE: **TEQIP-II/NITD/383 (RF Sputter Coater)**
5. BID REFERENCE: **TEQIP-II/NITD/384 (High Temperature CVD Furnace)**

DATE OF OPENING OF BIDS : **24.04.2014.**

PLACE OF OPENING OF BIDS : **Department of Physics,  
N.I.T., Durgapur**

TIME OF OPENING OF BIDS : Starting at 10 am, with one hour for each of  
the above item with a lunch break of one hour  
between 1 pm and 2 pm following sequence of  
items as above.

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**Specifications for Scanning Electron Microscope (Bid ref: TEQIP-II/NITD/379)**

1.	Resolution	1nm or better@30 kV, or 1.5nm or better @15 kV and must be better than 3 nm @1kV.
2.	Magnification	Highest X800,000 or more
3.	Vacuum System	Suitable vacuum system having all necessary pumps for high vacuum operation
4.	EHT	≤500V to 30KV
5.	Electron Gun	Field emission source. Appropriate no. of emitters for three year continuous operation
6.	Chamber	Large chamber with at least 7 accessory ports.
7.	Stage	5 axis motorized stage accommodating samples of upto 100 mm dia with full rotation and Tilt ≤0 to 70°or more, R=360°
8.	Electron Optics	Beam Deceleration/Gentle beam/Beam Booster/technology or equivalent for high resolution imaging at low KV
9.	Probe Current	Upto 200 nA or higher
10.	Detectors	a) Chamber mounted SE detector. b) Separate In-Lens SE detector/ In column detector/Upper detector or equivalent if necessary for high resolution imaging as specified in section 1
11.	User Interface	Keyboard, Mouse, Control Panel with multifunction for the control and adjustment of frequently used SEM parameters
12.	Accessories	a) Two 19” or more TFT Monitors b) High resolution printer. c) Infrared chamber scope (IRCCD) d) Control panel for adjustment of various SEM functions like focus, magnification etc. e) Chiller f) Compressor
13.	Other items to be quoted separately and individually	a) Gold /platinum coater. b) BSE detector or equivalent technology d) O ring kit. e) Suitable UPS with 1 hour back up. f) Liquid nitrogen free detector for EDS, resolution 129 eV or better with 30 mm <sup>2</sup> detector area. g) EDS analysis software with Co standard. h) Interface between SEM and EDS

**Calibration standards:** Standard samples to check system calibration i.e., magnification etc. should be supplied along with the system.

**Warranty:** One year comprehensive warranty on all components at buyer’s site. Party must also separately quote two years extended comprehensive warranty after the expiry of normal warranty in a year-wise manner. Cost break up for each year may be given. Certificate stating the availability of spares for next 10 years from the same manufacturers needs to be provided.

**Pre-installation requirements:** Supplier should have at least 10 SEM installations in India in last 5 years in reputed Govt. organizations. Supplier should specify the acceptable room size, limits of EM field, mechanical vibration and power rating, temperature, humidity etc. for installation.

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## Specifications for Raman Spectrometer (TEQIP-II/NITD/380)

The equipment should have the following specifications:

**1. Spectrometer:** High efficiency Spectrometer with

**a. Monochromator:**

- i. Spectrometer Range: 300 nm – 2000 nm or better
- ii. Raman Spectral Range : 50  $\text{cm}^{-1}$  to 4000  $\text{cm}^{-1}$  for visible laser  
200  $\text{cm}^{-1}$  to 4000  $\text{cm}^{-1}$  for UV laser
- iii. Spectral resolution better than 1  $\text{cm}^{-1}$  (FWHM) for all laser line excitations
- iv. It should have a motorized turret for at least two gratings
- v. Motorized entrance slit
- vi. Mounting arrangement for detector (CCD/ICCD)
- vii. Stray light should be low.
- viii. Precision feedback controlled suitable grating to achieve above specified points

**b. Detector**

- i. CCD array detector
- ii. Peltier cooled to  $-70^{\circ}\text{C}$ . No water or liquid nitrogen to be required.
- iii. CCD range: 200 nm to 1 micron
- iv. Motorized neutral density filters to offer at least 8 different output power level
- v. Resolution should match with the spectral resolution of the Monochromator
- vi. Quantum efficiency  $\geq 30\%$  in the wavelength range of 300-1000 nm
- vii. Low etaloning effect
- viii. Efficiency curve should be provided

**c. Grating**

- i. Suitable grating along with suitable mounting arrangements to achieve the quoted resolution within the specified spectral range
- ii. The efficiency of the grating should be uniform in the wavelength 300-1000 nm

**2. Microscope:** Confocal microscope for imaging, mapping & depth profiling with following

- a. Motorized XY stage, X~75 mm, Y~50 mm, step size~0.1 micro-meter.
- b. Motorized Z stage, minimum step size ~ 0.1 micron.
- c. Revolver equipped with minimum three objectives (preferably 10X, 50X, 100X)
- d. White light illumination and a color TV camera (with software to digitize and processing the images) for viewing the sample under Microscope.

**3. Lasers:**

- a. Laser – 532 nm ~ 50 mW or more, Air cooled with power supply included.
- b. He-Cd laser – 325 nm ~ 15 mW or more, Air cooled with power supply included

**4. Automation:** Auto switching of laser and motorized switching between laser and white light sample images

**5. Computer and Software:**

- a. Suitable latest computer and monitors of branded make
- b. Instrument control and data acquisition software licensed version, fully integrated data analysis and presentation software with image capture software for white light image display and capture.
- c. Software licenses for at least one offline user
- d. Raman Library

**6. System upgradability:**

- a. Any time with any laser within the spectral range specified
- b. Integration with NSOM and NSOM Fluorescence if configuration known

**7. Warranty:** One year comprehensive warranty on all components including lasers at buyer's site. Party must also separately quote two years extended comprehensive warranty after the expiry of normal warranty in a year-wise manner.

**8. Training:** The supplier should provide free training at the time of installation and commissioning.

**9. Vibration isolation:** Suitable table to isolate noise due to external vibration to be provided

**11. Other requirements:**

- a. System should be capable with suitable optics for Photoluminescence measurement
- b. Should contain all suitable filters for spectral measurement for the specified spectral range
- c. Complete coupling optics between confocal microscope and monochromator
- d. Laser diode back illumination system for alignment from detector to the sample.
- e. Support accessories/ electronics for interfacing computer with detector monochromator and other related electronics.
- f. Other useful accessories including special oil free tissue papers, tool box, cables, sample holder and manual.
- g. The bidder must quote break-up of price for any non-integrated components. Price comparison will be made based on the total price for all components and the purchaser has the right to discard some of the components.
- h. At least 20 successful installations of Raman system in India in reputed Govt. organizations. End user certificate to be provided.
- i. Certificate stating the availability of spares for next 10 years from the same manufacturers needs to be provided.

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## Specifications for Atomic Force Microscope (TEQIP-II/NITD/382)

1. **Name of the Equipment:** Atomic Force Microscope
2. **Purpose/Application:** NIT Durgapur requires a complete stand-alone high-resolution 'Atomic Force Microscope' to measure the three dimensional surface profile (both in 2D and 3D) of metallic and non-metallic samples including optical samples.
3. **AFM System and its components:** The complete stand-alone Atomic Force Microscope should include the cantilever, tip/probe, XY positioning stage with appropriate controller, PZT tube with amplifiers/power supplies (if required), laser source, position sensitive photo detector with associated controller electronics, other necessary electronics/power supplies, interface cables, and required instrument interface boards, and software for control of the atomic force microscope and for data analysis.
4. **AFM system must be equipped with the following:**
  - a. **Operating environment:** The atomic force microscope will be operated in ambient (air) laboratory (No clean room of any class will be made available).
  - b. **Measurement capability:** 2D and 3D "contact" surface profile measurements. The (X, Y, Z) motion required to image the surface must be accomplished with a piezoelectric transducer (PZT) tube and/or Flexure stage scanning.
  - c. **Measurement Modes:**

**Compulsory modes of operation:** Contact, Non-contact, Intermittent-contact, Phase Imaging, Force Modulation, Lateral force Microscopy, Force-distance measurements, Adhesion force microscopy, Magnetic force microscopy (MFM), Nanolithography, Electrostatic force microscopy (EFM), Scanning Tunneling Microscopy (STM), Scanning Tunneling Spectroscopy

**Further, the system must be compatible/upgradable** to Conductive AFM, Thermal Analysis. Nanoindentation, Liquid imaging, controlled temperature imaging and controlled environment imaging (e.g. in dry air, N<sub>2</sub> etc.). The cost of these upgrades to be given separately and individually as optional.
  - d. **Light Source/Detector.** Detector should be a position sensitive photo detector (PSPD)/Super Luminescent Diode (SLD) that is optimized for the laser light.
  - e. **AFM Geometry:** There must be provision to fit samples of 25 mm x 25 mm x 10 mm in size. Stage should be capable of accommodating sample weight of 100 gm or more.
  - f. **Tip/Sample Viewing:** AFM scanning cantilever/probe and test optical surface should be viewable on axis in real time via microscope optics. CCD camera for recording video image should be provided.
  - g. **Calibration samples and tips:** Appropriate calibration sample(s) for scanner calibrations in X, Y and Z in the range of few Angstroms to few Microns to be provided. At least five tips for each operating mode to be provided.
  - h. **Software & Interface:** Lifetime free upgradable software and interface for control of the atomic force microscope and for analysis of acquired data to be provided. In addition the **software should have the following capabilities:**

Automatic cantilever spring constant calibration, Cross section analysis, Roughness measurement, Grain size analysis, Depth analysis, Power spectral analysis, Histogram analysis, Fractal analysis, Fourier analysis, Autocorrelation, Force-distance curve analysis, Plane-fit, 2D and 3D height presentation
  - i. **Vibration isolation table:** A vibration isolation table (passive) suitable for vibration free operation of the AFM (and accessory if needed) is to be provided.
5. **Performance Requirements/Specifications:** The following table is a summary of the desired performance specification requirements for the Atomic Force Microscope:

Vertical (Z) Noise Level	0.5 nm rms
Lateral X-Y stage travel range	10 mm x 10 mm or more
Lateral travel (imaging) resolution	1.1 nm or better

Maximum scanning area	X-Y Scanning: 50µm x 50µm or more Z scanning: 7µm or more Each axis of motion should be independent
PZT tube/scanning stage resolution	Full 16-bit resolution on all axes (X, Y, Z), for all scan sizes and offsets. "Image" data resolution software should allow minimum 2048 x 2048 "pixels", for the selected scan size.
Repeatability (unidirectional)	~ 3µm (desired), ~8µm maximum
Microscope Optics	Digital/CCD camera
Installation & Training	Installation at buyer's site and necessary training to buyer.
Warranty	Two years extended comprehensive warranty at buyer's site after the expiry of normal warranty of one year, to be quoted separately in a year-wise manner.

**6. Other essential requirements the party must meet to become a qualified bidder.**

- a. The **offered model** should have **at least one** installation/purchase order in a reputed Govt./Govt. aided institute (End user certificate/confirmed purchase order is essential for the offered model). The OEM must provide the evidence that they have been manufacturing AFM for at least last five years **or** must have installed **at least ten** AFM systems in reputed Govt. organizations in India. Name and location of the technical support team need to be furnished. The supplier has to demonstrate the performance of the machine as per claimed specifications during installation.
- b. The bidder must quote break-up of price for all non-integrated components. Price comparison will be made based on the total price for all compulsory modes and accessories listed in section 4 and the purchaser may discard some of the essential modes and accessories to be bought.
- c. Certificate stating the availability of spares for next 10 years from the same manufacturers needs to be provided.

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## Specifications of RF Sputter Coater (TEQIP-II/NITD/383)

**Name of the Equipment/Item:** RF Sputter Coater

**Purpose:** To deposit thin films of metals, semiconductors and oxide in a controllable fashion

**The RF Sputtering System should have the following features:**

1. A stand alone model suitably configured for the sputter sources and substrate holders
2. Should be able to deposit any combination of metals, metal alloys, composites, semiconductors, insulators on semiconductor/glass/metal/alloy substrates in a single run.
3. Should accommodate targets of 2" (inch) diameter.
4. At least two magnetron sputtering sources placed in a confocal configuration for co-deposition as well as for multilayer deposition without breaking the vacuum.
5. The instrument should have water cooling arrangement to the magnetron sources to ensure uniform cooling of the target during sputter deposition.
6. The quoted magnetron sources should be compatible with any of the DC, pulsed DC and RF power supply.
7. One RF power supply of minimum 300 Watt at frequency of 13.56 MHz with auto matching network (reputed foreign make, such as, SEREN/ Advanced energy/ Comdel or equivalent for both the RF generator and RF Matchbox) should be connected to each of the sources.
8. One DC power supply of minimum 1000 Watt.
9. The instrument should have field upgradability to connect any of the two magnetron sources to DC and/or pulsed DC power supply.
10. A substrate holder to accommodate substrates of maximum size 2"X2" with rotation up to 10 rpm.
11. Substrate heating up to 800°C with temperature uniformity of  $\pm 2^\circ\text{C}$  over the 2"X2" substrate.
12. The heating element used for substrate heating in item (11) should be compatible with vacuum, plasma and/or reactive environment.
13. Should provide thickness uniformity of  $\leq 5\%$  over a substrate area of 1.5" or more diameter for the sputter deposition of any one or combination of metal/metal alloy/composite/semiconductor/insulator.
14. Specimen holder to provide rotation while heating and distance adjustment from the target.
15. The vacuum chamber should be made of electro-polished SS 304 material with optical view port for plasma viewing with shutter arrangement to avoid material deposition on the view port.
16. Ultimate chamber pressure of  $1 \times 10^{-6}$  mbar or less to be achieved in less than two hours of pumping time from atmosphere. Should be equipped with high vacuum valves.
17. Turbo Molecular Pump of imported make (such as PFEIFFER, LEYBOLD/ AGILENT/EDWARDS etc.) backed by suitable Rotary Vane pump to achieve the desired vacuum level mentioned in item (16).
18. Suitable digital vacuum gauges to measure the chamber pressure at the start of any of the pumping systems as indicated in item (16).
19. Demonstrable leak rates better than  $1 \times 10^{-9}$  std cc/sec for the quoted sputtering unit by using Helium Mass Spectrometer Leak Detector.
20. Should have a thickness monitor (of imported brand) integrated into the system to accurately measure the thickness of the deposited film
21. Provision to carry out reactive sputtering in oxygen, nitrogen and reducing atmosphere.

22. Three gas inlets through stainless steel pipes to be controlled by needle valves for flow of Argon, oxygen and nitrogen into the sputtering chamber.
23. Safety device to tackle emergency situations such as power cut, water circulation failure etc.
24. The instrument should include suitable capacity water chiller with pipelines, inlet/outlet valves, compressor etc.

**Other terms and conditions:**

**A. Warranty:**

Two years extended comprehensive warranty at buyer's site after the **expiry** of normal warranty of one year, to be quoted separately in a year-wise manner. Cost of any spares required for making the instrument operational during warranty is the responsibility of the vendor.

**B. Training and demonstration:**

Vendor should provide training on operation and application at buyer's site after installation.

**C. User list with contacts:**

At least one installation of similar system in last three years in any reputed Govt. organizations. End user certificate to be provided.

**D. Spares:**

The supplier of the instrument must confirm in writing that the spares for the entire system will be available for a period of at least ten years after the installation of the instrument.

**E. Demonstration and standards:**

Specifications quoted should be demonstrable on site at the time of installation using Standard specimens to be provided by supplier..

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## Specifications of High Temperature CVD Furnace (TEQIP-II/NITD/384)

**Name of the item:** High Temperature tube/CVD Furnace system

**Purpose:** Growing films of Graphene and CNT on various substrates by thermal CVD

The Horizontal Tube furnace system is a complete stand-alone system which can be used for growing graphene or carbon nanotube without using any additional component apart from those listed below:

### 1. The Furnace:

- a. Max. working temperature: 1200°C
- b. Continuous Working Temperature: 1100°C
- c. Heating element: SiC
- d. Heating Rate: upto 15°C /min or more
- e. Heating zone with minimum 250 mm length with +/- 1°C accuracy
- f. Suitable precision 30-segment programmable PID temperature controller (eurotherm) with +/- 1°C accuracy.
- g. High purity fused Quartz tubes to be provided with below dimensions:  
inner diameter:  $\geq 70$  mm, length  $\geq 1000$  mm

### 2. Vacuum System

- a. Suitable imported make turbo molecular pump backed by rotary pump to achieve vacuum levels of  $\sim 1 \times 10^{-6}$  mbar or better in less than two hours.
- b. Suitable vacuum sealing flanges and vacuum valves for leak free operation
- c. Appropriate safety devices for safe operation of the system
- d. Suitable vacuum gauges for vacuum monitoring

### 3. Gas Flow Controllers

Two Mass Flow Controllers (MFC) to control hydrogen (200 Scm) and hydrocarbon ( $C_2H_2$ , 200 sccm) with high precision (in units of sccm). One flowmeter/rotameter may be provided for controlling inert gas (Argon) flow. Additional bubblers may be provided if necessary. Suitable gas feeding lines to feed gases to the chamber through MFC and flowmeter with appropriate isolation valves should also be provided.

### 4. Other terms and conditions

#### a. Warranty:

Two years extended comprehensive warranty at buyer's site after the expiry of normal warranty of one year, to be quoted separately in a year-wise manner.

#### b. Training and demonstration:

Vendor should provide us training on operation and application at NIT Durgapur after installation. The growth recipe for graphene/CNT may be provided for fast process time of the user.

#### c. User list with contacts:

Vendor should provide us detail list of installations in India with all contact details. At least one installation in reputed Govt. organizations in India is must. End user certificate to be provided.

#### d. Spares:

The supplier of the instrument must confirm in writing that the spares for the entire system will be available for a period of at least ten years after the installation of the instrument.

#### e. Demonstration and standards:

Specifications quoted should be demonstrable on site at the time of installation. Standard specimens if needed must be supplied.

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