SUSHOBHAN AVASTHI
Assistant Professor

T +91 80 2293 2949
E savasthi@iisc.ac.in
http://www.cense.iisc.ac.in/sushobhan-avasthi

December 31, 2018

To Whom It May Concern

Limited Tender for a SEM system at CeNSE, IISc.

This is an RFQ (Request for Quote) for procurement of a scanning-electron microscope system as part of an open tender for the Centre for Nano Science and Engineering (CeNSE) at IISc, Bangalore.

CeNSE is a multidisciplinary research department at IISc that houses a 14,000 sq. ft. cleanroom and characterization facility used by 50 faculty members from various disciplines at IISc. CeNSE is also a user-facility which has hosted over 6000 participants from more than 700 universities and institutes all over the world. Consequently, any tool in CeNSE receives significant exposure to scientific community in India and beyond. The vendors are requested to factor in the value of this exposure in to their quotes.

Being a user-facility puts additional technical burden on the tool. We need a tool that can tolerate heavy usage (at least 50 hours/week), has a high uptime, can be serviced and maintained for the foreseeable future (at least 5 years), and has a track record of reliability at comparable facilities in India and abroad. Details of existing facilities and the user program can be gleaned from:
http://nnfc.cense.iisc.ac.in/
http://www.mncf.cense.iisc.ac.in/
https://www.inup.cense.iisc.ac.in/

Procedure

1. Vendors will be required to submit a technical proposal and a commercial proposal in **two separate sealed envelopes**. Quotes in violation of this will be rejected.
2. **The deadline for submission of proposals is the 15thth of January 2019, 5:00 pm Indian Standard Time.** Proposals should arrive at the Main office, GF-15, Centre for Nano Science and Engineering, Indian Institute of Science, Bangalore 560012, India, on or before the above deadline.
3. The decision of the purchase committee is final.
4. The technical proposal should contain
    a. Relevant technical datasheets. The committee reserves the right to cross-check the information in these datasheets with publicly available information.
    b. A compliance table with 5 columns. The first column must list the technical requirement, in the order that they are given in the technical configuration below. The second column should describe the capability of the tool for that specific requirement. In case the technical requirement is a question, second column must provide a technical answer. Please be quantitative and consistent with the technical datasheets. Third column must specify whether the technical requirement is met with a “Yes”, “No”, or “Partially”. If the response is “Partially” or “No” the third column, the fourth column must explain the extent of the deviation and, if possible, the reasons for the deviation. The fifth column is for other

SUSHOBHAN AVASTHI
Assistant Professor

T +91 80 2293 2949
E savasthi@iisc.ac.in
http://www.cense.iisc.ac.in/sushobhan-avasthi

"Remarks". You can use it to compare your tool with that of your competitors or provide more details/justifications.

c. Technical capabilities of any *suggested* accessories/add-ons that may enhance the usability, capability, accuracy or reliability of the tool. Vendors are encouraged to quote for as many add-ons as their tool portfolio permits.
d. Any additional capabilities or technical details, that you would like to bring to the attention of the purchase committee. Vendors are encouraged to highlight the advantages of their tools over comparable tools from the competitors

5. The technical proposal will be evaluated against the technical requirement. Only vendors who meet the technical requirement will be considered for the commercial negotiation.
6. If multiple systems fulfill the requirements, vendors can offer multiple bids.
7. The commercial bid must contain:
    a. Itemized cost of the system and *required* accessories, such as software, power supply, etc.
    b. itemized cost, as an option, for any *suggested* accessories/add-ons that may enhance the usability, capability, accuracy or reliability of the tool. Vendors are encouraged to quote for as many add-ons as their tool portfolio permits.
    c. The quotes should be CIF Bangalore, India. So please include cost of shipping to Bangalore. The quote does not need to account for Customs duties.
    d. Please indicate the warranty provided with the tool. Warrant of 3 years of more is preferred.
    e. Provide itemized cost for *required/expected* spares for 3 years of operation. For sake of this calculation, the vendor may assume active tool usage of 50 hours/week. This number will be used to estimate the life cycle cost of the tool.
    f. The cost of annual maintenance contract. The details of AMC are given below. This number will be used to estimate the life cycle cost of the tool.
    g. Length of time that the tools will be supported with service and spares from the date of installation. Our requirement is that the tools be supported for at least 5 years from the date of installation. To quote lowest price, vendors often quote for obsolete or soon-to-be obsolete equipment. This is **NOT** acceptable. For a user-facility like CeNSE, it is vital that the equipment be serviceable and supported for the foreseeable future. The length of guaranteed support will be used to estimate the life-cycles cost of the tool.
8. As an additional option, provide cost of an annual maintenance contract (AMC) for 3 years, post warranty. The AMC must
    a. cover 1 scheduled and 1 emergency visit per year;
    b. The emergency visit should be supported with a 48-hour response window.
    c. clarify if maintenance will be done by a trained onsite engineer (CeNSE employee) or a specialist from the OEM.
    d. in case the OEM is foreign, clarify if maintenance will be done by a trained engineer from India (local representative or Indian subsidiary) or by a trained engineer from abroad.
    e. include an itemized list of spares (e.g. maintenance kits) that are essential for scheduled visits;

SUSHOBHAN AVASTHI
Assistant Professor

T +91 80 2293 2949
E savasthi@iisc.ac.in
http://www.cense.iisc.ac.in/sushobhan-avasthi

9. The commercial bids will be evaluated based on life-cycle cost of the tool. This includes the cost of purchase, maintenance, spares, etc.
10. The RFQ must include references of 3 previous installations, preferably in India. Please provide the names and contact addresses of the referees, so that the committee can contact them independently.
11. We encourage vendors to give technical presentations, physically or over Skype, so that we can better understand the technical capabilities of their tools and vendors can better understand the requirements. To schedule the presentations, the vendors can contact Dr. Savitha P, GF-20, Centre for Nano Science and Engineering, Indian Institute of Science, Bangalore 560012, India. (savithap@iisc.ac.in).
    Any technical questions can be directed to Dr. Savitha P, GF-20, Centre for Nano Science and Engineering, Indian Institute of Science, Bangalore 560012, India. (savithap@iisc.ac.in).

Technical Requirements

1.	Primary application	The tool will be used to characterize the wafers at various points of their fabrication process. a) Imaging with topographical/cross sectional information of semiconductor and MEMS devices including and not limited to lithographic and etched patterns, cross section analysis of thin films. Samples would include conducting and non-conducting layers. b) Capability to allow imaging of nonconductive samples -- mainly thin films of dielectrics (SiO2, SiNx, etc.) and polymers (photoresists, PMMA, etc.). This is the critical requirement. c) Capability to load a 4-inch wafer, although imaging will only be done at targeted areas.
2.	Secondary application (desirable but not required)	a) Capability to load and locally image a square-shaped 5-inch mask plate. Mask plate glass substrate coated with polymer/metal. b) Ability to distinguish organic (polymers) from inorganic (semiconductors, metals, dielectrics etc.,) materials
3.	Electron Source	a) FEG source capable of high-resolution. Must have 3 years free-replacement warranty.
4.	Beam current	a) Probe current 30 nA. b) As an option, upto 100 nA c) Please furnish a current vs. spot-size curve. This is mandatory.
5.	Resolution	a) ≤ 1 nm @ 1kV using SE detector. b) Mention the method used to measure resolution.
6.	Magnification	a) 20x to 1000000x or better
7.	Accelerating voltage	a) 20 eV to 30 kV in steps of at least 10 eV at lower end and 100 eV at higher end.

SUSHOBHAN AVASTHI
Assistant Professor

T +91 80 2293 2949
E savasthi@iisc.ac.in
http://www.cense.iisc.ac.in/sushobhan-avasthi

		b) Due to the need to image insulators, performance at low voltage is critical.
8.	Beam deceleration and landing Voltage	a) Landing voltage down to 20 eV b) Mention the beam deceleration method. Applying a bias to the substrate typically does not work well for insulating samples. ○ What else can the system do to image insulating substrates? ○ Can the deceleration be applied in the column?
9.	Vacuum System	a) High-vacuum chamber with base pressure lower than 10^{-5} mBar b) As an option, variable pressure mode. Mention the pressure range and also the effect on resolution. This capability must not affect the baseline resolution (mentioned above) when sample is being imaged at base-pressure
10	Detectors	c) In column/in-Lens SE detector and chamber mounted ET SE detector. d) BSE detector as an option. ○ Energy-selective detector. ○ Please demonstrate performance at low landing energy. e) EBSD as an option. ○ CMOS based EBSD camera with at least 1244 x 1024 pixels resolution and indexing speeds of 3000 pps or better. ○ The EBSD system angular resolution should be < 0.08 deg. ○ The EBSD camera should have tapered nose design to prevent shadowing to other detectors of FESEMs. The EBSD camera should have motorised insertion and retraction mechanism with remote control digital handset. The position accuracy is to be 0.1mm. f) EDS as an option. ○ The EDS detector should SDD type having 40mm2 area or more to offer higher count rate for Elemental Analysis and Mapping applications. ○ The energy resolution should be better than 127eV on Mn-Kα ○ The EDS must be establish performance at low atomic number elements.
	Imaging	a) The SEM shall include a dedicated panel with knobs for controlling magnification, focus, and other frequently altered settings (e.g., image brightness, image contrast, and astigmatism correction), This dedicated panel may replace or duplicate control settings adjustable using a computer-driven microscope control interface. b) The SEM controller tools must support the following capabilities:

SUSHOBHAN AVASTHI
Assistant Professor

T +91 80 2293 2949
E savasthi@iisc.ac.in
http://www.cense.iisc.ac.in/sushobhan-avasthi

		c) Variable scan rate for fast focusing image updating, (Allows focus to be adjusted quickly while maintaining a slow scan rate or continuous averaging for low-noise imaging) d) Beam spot control e) User-calibratable, on-screen, point-to-point distance measuring, (Extremely useful for specimen feature dimensions) f) User-calibratable, on-screen, line-to-line distance measuring, (Extremely useful for specimen feature dimensions) g) Electronic image rotation and shift, (Useful in conjunction with line width measurement if the line width tool is not rotatable) h) Annotations, including but not limited to scale bar, SEM data, date time and detector information. i) User calibration, point to point measures, angle and other image measurements must be possible j) Images must be saved with resolution of 1024*768 or higher in BMP/TIFF/JPEG. k) Image processing features like different scan rates, integration continuous averaging. l) Auto-focus and stigmatism corrections. m) Appropriate hardware/software for image storage, editing, and analysis. Minimum 1 TB HD storage capacity.
11	Chamber	a) 5-axis compucentric or eucentric stage b) Motorized stage travel of X axis - 100mm, Y axis - 100mm, Z axis - 50mm, Tilt -4 to 90 deg or better, Rotation 0-360 Deg, give all available options c) Sample holder should be able to hold multiple small samples. d) Control of stage movement should be controllable through both computer and manual with joystick e) Stage position readouts for each axis, along with safety features to avoid collision f) Chamber mounted IR camera for optical view (stage movement and navigation aid) g) Fully automated vacuum control along with required safety features along with readouts for vacuum and SEM status. h) Pump down time (PDT) or evacuation time of less than 4 mins. i) Sample holders for single and multiple stubs – standard sample holder along with an option have stubs of various sizes (flat/angled), single/multiple stubs. Must also be able to accept full 4” wafers. j) Is additional access port possible (for future upgrade)? k) Mention the min/max weights the stage can handle.

SUSHOBHAN AVASTHI
Assistant Professor

T +91 80 2293 2949
E savasthi@iisc.ac.in
http://www.cense.iisc.ac.in/sushobhan-avasthi

12	Coater	l) Standard carbon coater to coat nonconductive samples and Au coater to coat steel samples. The coaters should provide the flexibility for changing the sputtering current and time in order to control the coating thickness.
13	Software	a) The software must allow varying levels of instrument access. A simplified basic access for a user, more access to superuser, and full access to an engineer. b) Must provide a comprehensive GUI-based software to manage and operate the system. Software must be in English. c) Interlock that can interface with the online reservation system, so that the tools can only be used by authorized users. d) Complete logs of all the process and system parameters to be available and stored for future trouble shooting e) Provision to alert the user in case of emergencies and an option to integrate the alarm system to NNFC building monitoring software f) Specify the date the tool was launched, and the period till which the software will be supported. Software must be supported for at least 5 years from the date of installation. g) OS should be latest/new version software, with compatible workstation including 24” Display(s) or higher. E.g. if Windows-based, please provide a Windows 10 OS. h) Stage navigation system is required. i) Detailed manuals stating all the features, requirement, standard operating procedures, and basic troubleshooting j) Provide control CPU with the required capabilities. Latest compatible branded high-speed computer with preloaded licensed software for SEM operating parameters. Detailed specifications of the workstation to be provided
14	Other specifications	a) Dry vacuum pumps and turbopumps are preferred b) The SEM shall include a separate monitor displaying the acquired image over nearly the entire viewing area, this image display monitor shall be included in addition to a monitor displaying the microscope condition and control functions c) The supply of spares is guaranteed for 5 years from the date of first AMC contact. d) Operation table e) Chamber scope
15	Footprint & weight	a) System must be compatible with Class 100 Clean room/ISO 7 standards. b) Please specify the total foot print in cm x cm, and weight. c) All site requirements must be clearly mentioned.

SUSHOBHAN AVASTHI
Assistant Professor

T +91 80 2293 2949
E savasthi@iisc.ac.in
http://www.cense.iisc.ac.in/sushobhan-avasthi

16	Periodic Maintenance	a) Assume a tool-usage of 50 hours/week for all calculation in this item. b) The system should require minimal maintenance. c) List the recommended preventive maintenance schedule for the system, including the frequency, procedures, and accessories needed e.g. O-rings, etc. The cost of these *required* or *recommended* accessories should be mentioned be given in the commercial document, as specified in 7.e of the Procedure. d) Please provide the technical scope of a 3-year AMC, post warranty, including the items in any maintenance kit.
17	Installation and Training	a) Installation and expert training at CeNSE, IISc, Bangalore, must be part of the package. b) The expert should be not only trained in operating but also know the installation requirements for smooth uninterrupted functioning of the SEM c) During the installation all the specifications of the processes/tool will be verified for acceptance tests. Details are given below. d) Can the periodic maintenance can be done by the on-site CeNSE engineer? If yes, then please include the cost of training the engineer in the commercial bid
18	Power & utilities	a) The instrument should work with Indian electrical standards b) Mention the power requirement. c) Mention ALL utility requirement (water, air, exhaust, cooling, etc.) d) Mention environmental restrictions, i.e. operational temperature, humidity etc. e) Support hardware, such as chillers, air compressor and UPS requirements, if any, must be mentioned. f) Mention requirements such as clearance (space to move the equipment in through the door/corridor, etc), tolerable limits of EM field and vibration (mechanical) g) Any extraordinary requirement that need validation/survey must be done by the supplier in advance, so that installation is not delayed
19	Safety	a) Mention any special safety requirement of the tool b) The tool must come with a complement of interlocks to prevent common user errors. c) Any malfunction should have an audible alarm system. d) Flashing indicator lights are required to signal tool status: “standby”, “in-use”, & “error/emergency” e) There must be an emergency stop button on the front panel.
20	Previous user recommendations	a) The system must submit references from at least 3 previous installations, preferably in India.

SUSHOBHAN AVASTHI
Assistant Professor

T +91 80 2293 2949
E savasthi@iisc.ac.in
http://www.cense.iisc.ac.in/sushobhan-avasthi

		b) The names and contact addresses of the referees must be submitted with the proposal, so the purchase committee can contact them independently.
21	Pre-purchase testing	a) To ensure the equipment conforms for specifications, the committee may ask vendor to perform some standard tests *before* the purchase process is complete. The tests will be used to confirm the performance of the system. b) Results that are inconsistent or inferior to claimed performance, may be grounds for rejecting the tender. c) The vendor must conclude the testing and submit the data within 1 week of receipt of samples.
22	Acceptance tests	a) Cross-sectional imaging and measurement of 5 nm of gold on Si b) Cross-sectional imaging and measurement of 10 nm SiO2 on Si c) Cross-sectional imaging and measurement of 200 nm PMMA on Si d) Demonstrate working of all accessories

Thanking you,

Sushobhan Avasthi, Ph.D.
Cell : +91-99-0233-3360
Office : +91-80-2293-2949
E-mail: savasthi@iisc.ac.in