Reply to the queries raised during Pre-bid meeting held on Aug 11, 2023 (Ref. No. FM-PRJ-GeM-028-23-24) For the procurement of FESEM with EDS and EBSD

Thermofisher

Technical Specification for FESEM with EDS and EBSD: Request for changes

S/N	Required Item	Required specification	Request for changes in the technical specifications	Response from IIT(ISM)
3	Electron Optics	· Electrostatic lens technology/hybrid lens design/equivalent lens design for high resolution imaging of magnetic materials with a shorter working distance (2/3mm). The firm must ensure that the quoted model is capable to analyze magnetic samples. · Lenses must be water cooled / equivalent techn ology cooled.	· We request to keep the lens cooling by **water cooled technology only** (removing the equivalent technology cooled) **Reasons/Justifications:** *Water cooled technology is the best suitable technology available as on date towards keeping Lens cooling most stable way compared to air cooled technology.*	Accepted
4	Resolution	· 1.4 nm or better in 1kV · 1 nm at 15 kV or better 0.7 nm or better at 20 kV · The resolution must be guaranteed within the ope ration vacuum range. · The resolution must be achieved in a current conf iguration of 300 nA or more.	Requesting for changes as given below: · **1.2 nm** in place of 1.4 nm in 1 kV **Reasons/Justifications:** *The key purpose of Field Emission Gun (FEG) electron source in SEM system is to achieve high resolution imaging in lower Accelerating Voltages. If we set the low acceleration voltage at 1 kV, better we get*	**1.3 nm** in place of 1.4 nm in 1 kV

			the resolution, the FESEM system will be better in quality & capabilities, or vice versa. Hence, the above change in resolution in 1 kV has been requested.	
5	Magnification	▪ 10x to 10,00,000x or better	Requesting to change the magnification at lower side **50x** in place of 10x. Also, requesting to make the higher side up to **20,00,000x,** in place of 10,00,000x. **Reasons/Justifications:** *If you see application wise, there is no use of magnifications below 50x in any SEM or FESEM systems, mostly it is used with more than 50x magnifications. Our system's magnifications start at 15x and go to 20,00,000x or more. but to generalize it, we have requested to keep it 50x at lower side. And if possible, may please keep it more, say, 20,00,000x. Since it is high resolution imaging system, higher the magnification, it will be better of course.*	Modified to 15x to 20,00,000x or better
7	Detectors	· In-chamber IR camera for viewing the sample inside the chamber under vacuum condition · Chamber mounted Secondary Electron (SE) detector. · In-lens SE/In-Column SE/Upper SE Detector or equivalent technology of imaging of SE1	We request you to add two more detectors: - **A separate In-Lens / In-column Back Scattered Electron Detector** (**In-Lens BSED**). - **Navigation camera inside the specimen chamber controlled through software.** **Reasons/Justifications:**	• We have added In-chamber IR camera, **controlled through software,** for viewing the sample and **its movement** inside the chamber under vacuum condition • **In-Lens / In-column Back Scattered Electron (BSE) detector**

				also added.
		· Retractable semiconductor type backscattered electron detector	- *The basic reason for having In-Lens detectors in FESEM system is to achieve high resolution imaging detecting even the low energy electrons (both SE and BSE). For getting high resolution secondary electron imaging, an In-Lens / In-column SE detector is needed. Same way, to achieve high resolution back scattered electron imaging or atomic contrast or composition contrast imaging, a separate In-Lens BSED is needed mandatorily. And all the manufacturers are having the same. Hence, we requested the same to include for the system capability to hike, and with no additional cost!* - *The navigation camera helps to navigate while multiple samples are loaded in the specimen chamber and to navigate them depending on priority of the user, just seeing them in the display. And that navigation can be controlled through the software which is integrated to the system software. This is much easier method to handle the multiple samples to analyze in FESEM. That is why we have requested to keep it in the configuration, and all the manufacturers are having the same.*	
11	Vacuum	· Pumps: Ion Getter Pump (IGP)/Sputter Ion Pump (SIP), Turbo Molecular Pump (TMP), and oil free Rotary Pump (RP) or Oil Rotary pump (the firm must provide all consumable items including oil for oil rotary pump for 5 years)	Requesting you to keep **Oil-free Rotary pump** or **Scroll Pump** in place of Oil rotary pump. **<u>Reasons/Justifications</u>:** *Since you are going for latest FESEM system, the same should be completely oil-free, dry pumping system, shouldn't*	Oil free rotary pump accepted

		· Isolation valves for specimen chamber and high vacuum system · Automatic venting · Faster vacuum recovery (5 min or less)	*keep minimum chance for oil contaminations by oil misting. This is our request to keep the same system completely oil-free.*	

Labindia

Item Sl. No. 2 : Please add both Beam booster / Potential Tube & Stage Bias / Beam Deceleration, as both the technology works in different way and is not comparable technologies instead of either one technology under Acceleration voltage/landing energy.
Beam booster/potential tube reduces spherical aberration & chromatic aberration inside column by booster voltage of around 8 kV.
Stage bias/Beam deceleration Bias sample with High voltage and reduces sample interaction volume. (This improves resolution for practical sample as resolution are mainly reduced due to interaction volume)
Hence, we suggest you to go for the system which provides both the technologies. Every manufacturer of FESEM has a model which can provide both.

Response - We have accepted the suggestion and added both the technologies in the revised tech specification.

Item Sl. No. 4 : Please change the Resolution from 1.4 nm or better in 1kV to 1.2 nm @ 1 keV as system with 1.4 nm resolution @ 1KV are considered as entry level system where as System with 1.2 nm resolution @ 1 KV are considered as mid-level FESEM where you can get Ultra High Resolution compare to entry level system.

Response – Partially accepted. We have changed the resolution to 1.4 nm or better at 1kV to 1.3 nm or better at 1 keV

Item Sl. No. 07 : Please add in-lens BSE, under Detector which can differentiate between Carbon & Diamond O2 & O3 by collecting low loss BSE signal in combination with Energy filter. This is available with all the FESEM manufacturers. Some manufacturers call it in different name like Energy selective back scattered detector.

Response – Accepted. We have added in-lens BSED.

Item Sl. No. 20 : Please add plasma cleaner as it is critical to maintain chamber & sample clean for long-time high-resolution imaging. With out this the resolution keeps deteriorating over a period of time due to chamber contamination and results in charge build up and poor quality of images.

Response – Accepted.

Additional Points 1 : We request you to please allow bidders to provide item wise price of accessories in GeM as it will help the purchaser to evaluate bid as per the budget.

Response – Not possible in GeM.

Additional Points 2 : As the cost of FESEM with EDS & EBSD goes in few Crores so we request you to please make some provision of partial payment after successful delivery to IIT Dhanbad.

Response – Purchase section will decide as and when required.

SAANS analytical

SL No.	Required Item	Required specification	Amendment request	Response from IIT(ISM)
4.	Resolution	· 1.4 nm or better in 1kV · 1nm at15 kV or better 0.7 nm or better at 20 kV · The resolution must be guaranteed within the operation vacuum range. · The resolution must be achieved in a current configuration of 300nA or more.	· 0.9 nm or better in 1 KV · 0.8 nm or better in 15 KV or better (without STEM resolution) · The resolution must be achieved in a current configuration of 200nA or more.	Not Accepted
5.	Magnification	10x to 10,00,000x or better	· 20X to 20,00,000 X or better	Partly accepted. We have modified it as10x-20,00,000X
6.	Probe current (nA)	4 pA or lower to 300 nA or higher; fully adjustable	4 pA or lower to 200 nA or higher; fully adjustable	Partly accepted. We have made it: 4 pA or lower to 300 nA or higher
7.	Detectors	Retractable semiconductor type backscattered electron detector	Retractable semiconductor type 5 segment backscattered electron detector	Retractable semiconductor type BSED accepted
8.	Specimen chamber and specimen stage	· Stage movement X = 100 mm or more; Y = 100 mm or more; Z = 49 mm or more; Tilt = -	· Kindly amend it Z=40 mm, other Stage movement are ok for us.	Not accepted

		5° to +70° or better; Rotation = 360° - continuous.	· Kindly include the maximum sample diameter upto 150 mm or better · Kindly include SEC or sample exchange chamber (side loading or front loading) for sample exchange without breaking the chamber vacuum.	
14.	EBSD	The position accuracy is to be 0.1mm or better	· You may go with 0.05 mm	We have fixed it to 0.1 mm

Ametek:

1. For Point no 13 of EDS

It has been mentioned for resolution of EDS < 129eV at Mn K alpha , As discussed we would request you to change it to 127eV as per the present market trend ,where you will be using your system for Basic and research end both. Pls note 127eV resolution is available with all the parties (Edax , Oxford model Ultim 40 127 eV) and all the parties will be providing same kind of system . and since you are getting better resolution that 127 eV compare to 129eV , you will have much sharper peaks of EDS resulting better deconvolution that is less peak overlap .

Reply: Accepted

2. Apart from changing this resolution part would request you to keep all the other parts intact (no change) in order to have better system .As any other small changes even can dilute specs and you may not get the best configuration within budget.

Reply: Thank you for your suggestion

3. For point 14 in tender r it has been mentioned

For minimizing the grain size artifacts for us we are having the Hexagonal scanning grid which provides constant and consistent between the neighbouring pixels but for others we would request you to take documentary evidence what they are offering , as grain shape artifacts can have serious impact on local misorientation analysis .

Reply: For minimizing the grain shape artefact, we have stated our preference. However, any emphasis on hexagonal scanning grid was not provided.

3.For database as discussed would request you to put ICDD pdf 4 instead of ICSD , as iCDD pdf 4 which has almost 4.28 lK entries and it widely used among the people who are using EBSD , also the EBSD software must have the feature of accessing the Database base directly from the phase list of the EBSD software, otherwise the files needs to be import in .ctf format form the database manually using sperate computer , and then it needs to put in the EBSD pC .

Reply: Not accepted.

4.For warranty we would request you to go for 2 years warranty on the main item as essential , and additional 1 year warranty in option , to match it with budget .If you have some left over money then you can go for the warranty initially or you can fix the amount and give the amount to the manufacturer on 3rd year , this kind of arrangement will also save your duty as, if you buying at first ten you need to pay the duty on the warranty also

Reply: Not accepted. As per the institute norm, 3 years warranty is included.

Oxford Instruments:

Tender spec. no.	Tender specification	Our Remarks	**Response from IIT(ISM)**
13	Energy resolution: < 129 eV at Mn-Kα. For C ≤ 50 eV.	With the Carbon resolution specified in the tender, it appears the requirement is of the high end EDS detector. This will significantly increase the price of the EDS system. We understand that the total available funding for this tender requirement is not very high and hence we suggest to specify the Carbon Resolution at 60eV. This will ensure that the price	Not accepted. Carbon resolution has been kept fixed at ≤ 50 eV.

EDS Detector		of the EDS system doesn't go up significantly.	
	Capable of detecting elements from Be (4) to Am (95)	All the EDS manufacturers guarantees the Quantification of elements ranging from Boron (B) onwards only. If that is the case, why to keep the detection element range from Be(4) onwards. We suggest to amend the detecting elements from Boron (5) to Am(95) and/or above. This will ensure the detector cost doesn't go up.	Not accepted Detecting limit has been fixed for from Be (4) to Am (95)
	phase mapping with specimen drift correction,	As we all know, EDS is meant for elemental analysis and not for phases (compound) analysis. Hence Phase studies is best done using EBSD. Since institute is buying EBSD as well, phase analysis/mapping would be best done using EBSD system. Adding Phase Mapping specification to EDS system would increase the price of the EDS system. We thus suggest to keep this requirement as option.	Phase mapping has not been included as an option
	NIST certified standard sample set for quantitative EDS must be provided for calibration purpose.	We just need one single element sample such as Ni,Cr,Fe,Co or Cu for energy calibration and It can be easily obtained by the user. As regards to quantification, we supply the EDS system wherein these standards required for quantification are already stored internally. These standards are then used for Quantification. We supply two sets of internally stored standards viz one, acquired at 20kV and another at 5kV. User can select these set of standards based on the acquisition conditions such as at low kV or at high kV. Since we obtain very good results with these internal standards, we feel buying additional Standards will only add to the cost. In our experience, users buy these standards and seldom use it later.	Not accepted. NIST certified standard sample set for quantitative EDS must be provided for calibration purpose.

		We thus suggest to remove these standards from the tender specifications. It can always be bought later.	
14 EBSD detector	The camera should have suitable features (should be guaranteed by vendor based on the available features) for minimizing grain shape artifacts, and also to provide consistent distance between neighboring pixels which is important for local misorientation analysis of deformed materials.	*To achieve the highest precision misorientation measurements (for example to characterize subtle subgrain structures, or to resolve the strain around individual dislocations), Oxford Instruments has developed a patented indexing mode called "Refined Accuracy". The increase in angular precision offered by Refined Accuracy enables the user to use EBSD to map small orientation changes.*	Precision requirement has been modified with **partial acceptance**
	The EBSD software should have feature so that the Signal to noise level can be improved by averaging each pixel with its surrounding neighboring pixels.	*The Symmetry EBSD detector utilizes unique fibre-optic coupling between the phosphor screen and the sensor, which significantly improves the signal-to-noise ratio and the quantum efficiency of the detector. Hence there is no need for pixel averaging required to enhance the signal.*	Accepted. No pixel averaging is mentioned.
	(x) ICSD database,	*We do supply ICSD database* which includes Over 59,000 phases of wide coverage across all inorganics, including minerals, ceramics and metals/alloys. For ICSD database, the full crystal structure data reviewed and maintained by orschungzentrum	Accepted.

		Karlsruhe government laboratory, Germany. *We do not use ICDD database as we firmly believe that the* **database built up using XRD diffraction data when used directly with EBSD analysis can lead to indexing Errors as there can be significant difference between XRD reflector intensities and Kikuchi diffraction intensities for EBSD** We also supply the TWIST program along with AZetc EBSD software that allow user to add any other unknown phase data to database.	
	The software should be compatible with Windows 10 or above	Windows 10 is already outdated and Win 11 is the latest platform available now. We recently understood that INDIA government doesn't allow importing of outdated software. We thus request you amend it to read as WINDOW 11.	Accepted