CENTRE FOR NANO AND SOFT MATTER SCIENCES
Arkavathi, Shivanapura, Bengaluru North 562 162

No. CeNS/2023-24/Tender of X-ray photoelectron spectrometer

Date: 15th March 2025

Annexure I (New)

Schedule of requirements

Sl. No	Requirements/ Parameters/ Parts	Specifications in detail	Technical compliance (Yes/No)	Remarks
		Essential items		
1	General Requirement	Monochromated microfocus XPS system with complete automation and state-of-the-art data system enabling: • XPS (X-ray Photoelectron Spectroscopy) • XPS mapping • Advanced depth profiling (high resolution) and surface cleaning sputter ion gun • An inert gas ion gun for sputter etching the sample • Vacuum transfer module for handling air sensitive samples • RXPS (Angle Resolved XPS) - tilted mode operation in the range of +/- 90 degrees • Should perform sample imaging with resolution of 10 µm or better • Minimum 5 software license for processing and analysis • Remote control operation facility of the instrument from desktop/laptop via internet or wifi. Very low data collection time (10 min.)		
2	Complete system	Ultra High Vacuum Analysis Chamber with following specification: Double-focusing hemispherical energy analyzer, sample manipulator with 4 axes of movement, sample introduction system, sputter ion source for surface cleaning and depth profiling, X-ray monochromator, automated UV source for UPS, flood gun for charge neutralization, water chiller, vacuum pumping system with a base pressure of $5x10^{-9}$ mbar or higher after the bake out, UPS back up for pumps and all the spectrometer electronics, all software and computers for a minimum of 30 minutes		

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		Analysis chamber should be and up of single piece precision-machined Mu metal or Ni-Fe alloy to obtain UHV and shield from magnetic fields		
3	Vacuum System	The analysis chamber should be fitted with a turbomolecular pump (250 L/sec for N_2 or better) with a suitable backing pump and auxiliary titanium sublimation pump (TSP). The TSP should comprise of 3 filaments. The TSP control should allow for the following firing options: auto-degas, timed-fire (operator programmed firing during experiment sequences), and a mode in which it is disabled during data acquisition. The base pressure in the analysis chamber should be 5 x 10^{-9} mbar for better after the bake out.		
4	Sample entry system and sample manipulator	• Assisted with turbo-molecular pump (200L/s for N2 or better) • Sample holder kit • Facility to load multi samples at a time Vacuum Transfer Module: A sample holder capable of transferring samples from a glove box environment to the vacuum system without exposure to air must be supplied. The sample holder must be able to transfer samples into the vacuum system without operator intervention once the transfer vessel has been introduced into the sample load-lock. Should be fully automated and have at least 5 axes of movement, X, Y, Z, and continuous azimuthal sample rotation. The sample holder and system configuration should allow for an analysis area of 60 mm x 60 mm and a maximum sample thickness of 20 mm.	•	•

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		Fast entry airlock (FEAL): This chamber should be made of aluminium and pumped using a turbomolecular pump and a suitable backing pump. The FEAL should be connected to the analysis chamber via an automated (low shock) gate valve. Transfer of the sample holder into the analysis chamber should be fully automated and integrated to the spectrometer's vacuum control software to preserve UHV conditions. A combination gauge should be supplied to measure the chamber pressure, and used to control the automatic sample transfer via the data system. A non-out-gassing sample must be transferred from the FEAL to the analysis chamber in less than 10 minutes from the start of pumping.		
5	Detector	Multi-channel detector with at least 128 channels for high sensitivity XPS. The detector should support a parallel 'snapshot' acquisition mode of operation for rapid data acquisition. Due to the need for high sensitivity at high spatial resolution, the instrument should be supplied with a large acceptance lens (≥ 50°)		
6	Analyzer	Electron Energy Analyzer with software package A hemispherical electron energy analyzer of at least 120 mm mean radius with minimum 128 channels detection, pulse counting unit with energy scan range between 100 to 1400 eV or wider with a minimum energy step of 5 meV or better. Analyzer control unit possessing the following count rates, at the specified resolution: Sensitivity ≥ 6.0 mcps@1.0eV of the Ag $3d_{5/2}$ peak, at a resolution ~~0.5 eV~~ ≤ 1.0eV (FWHM) or better, measured after removal of a linearly		

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		interpolated background and using an X-ray spot size of 400 um and an X-ray power less than 125 W. Binding energy range 372 eV to 365 eV. Sensitivity ≥ 400 kcps@1.0 eV of the Ag $3d_{5/2}$ peak, at a resolution of ≤ 1.0eV (FWHM), measured after removal of a linearly interpolated background, and using an X-ray spot size of 30 um and an X-ray power less than 5 W. Binding energy range 372 eV to 365 eV. Sensitivity ≥ 70 kcps@1.0 eV of the Ag $3d_{5/2}$ peak, at a resolution of ≤ 1.0eV (FWHM), measured after removal of a linearly interpolated background, and using an X-ray spot size of 10 um and an X-ray power less than 3 W. Binding energy range 372 eV to 365 eV. Both spot size and sensitivity should be determined with the sample normal parallel to the axis of the transfer lens. Specifications should be demonstrated using the anode power recommended for routine analysis at each spot size. Operating mode: Constant Analyser Energy (CAE)		
7	Source for X-Ray	Microfocused Monochromated X-ray source: Al K alpha Electron source: 12 ~ 20 keV nominal operating voltage The instrument must have excellent energy resolution for chemical state analysis and a guaranteed full width at half-maximum energy resolution on Ag $3d_{5/2}$ peak of 0.50 eV or better. The monochromator should include an electron suppression device to reduce the number of unwanted high-energy electrons reaching the sample analysis position. The quartz crystal monochromator goniometer should be motorized for automated or		

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		remote access X-ray spot alignment. To minimize X-ray-induced sample damage, the large area X-ray spot should have a power of less than 120 W. The monochromator control electronics and software should include auto-degassing and filament conditioning routines.		
8	X-ray spot size	X-ray spot should be user selectable and variable in the range of 10 um to 400 um with simple computer command. The X-ray spot size selection should be variable in 5 um steps from the smallest to largest spot to facilitate matching the analysis area to the feature of interest.		
9	Source for UPS	Automated UPS Source for Helium I / Helium Il for valence band spectroscopy: A gas discharge source capable of operating with noble gases must be supplied. All differential pumping, gas handling and source operation must be automated, so that it can be operated from the data system, and used within complex experiments such as depth profiles. The standard operation must be configured for use with helium, with the data system able to automatically start the lamp and operate in He(I) or He(II) modes. UPS performance must be demonstrated on a clean silver sample. Under identical spectroscopic conditions, a count rate of ≥ 2.0 mcps must be demonstrated when the resolution at the Fermi edge is < 120 meV. Resolution is defined as the energy difference between the points at which the intensity is 20% and 80% of the maximum value below the Fermi level.		
10	Flood gun Charge	The system should provide excellent charge compensation on		

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	neutraliser system	non-conductive samples, even when analyzing small areas. A system based on a combination of low energy ions and electrons is required. The ions and electrons should be produced from a single source. A single mode of operation should provide optimum neutralization for all sample and experiment types. The flood control should include automated Ar gas handling. The spectrometer data system should include both automatic filament degas and conditioning routines. The neutralization scheme shall effectively stabilize the surface potential of nonconductive specimens, and not cause damage to the specimen surface. This shall be demonstrated by performing an X-ray Photoelectron Spectroscopy measurement on a poly(ethylene terephthalate) [PET] polymer film, furnished by the Supplier. The measurement is described: No external mask on specimen surface, C 1s peak measured from 300 to 280 eV for 5 minutes, Background subtract, FWHM ≤ 0.85 eV for the O=CO component. The measured position of the C- H component at binding energy in the range 280- 290 eV (before any mathematical shift applied). The sensitivity should >15 kcps at 0.85 eV energy resolution.		
11	Argon ion source for depth profiling and specimen cleaning	Differentially pumped Ar ion sputter source with beam energy of 200 eV -4 keV or better with option of using Ar. Beam current of 4 uA or higher at 3 keV, spot size @ 3.5 uA and 3 keV should be 500 um or similar. Routine continuous operation at the maximum voltage and maximum current shall not be deleterious to the power supply.		

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12	Ar+ Cluster ion source	Ar+ ion source capable of surface cleaning and should be used for depth profiling experiment. Depth profiling and photoemission measurements (using x-ray and UV source) should be synchronized and automated. System should be capable of integrating high-performance ion gun, utilizing Argon gas, which is capable of operating in both cluster and ion mode for depth profiling and surface cleaning of both soft and hard materials. The outcome energy from Ar+ cluster mode should be variable from 1eV to 80 eV or greater per atom. Clear evidence must be provided if such a claim is being made.		
13	Automation	The supplied system must include automated features for sample handling, vacuum control, and data acquisition, allowing a spectrometer to be operated in a multi-user environment along with other analytical techniques. Remote control operation facility of the instrument from desktop/laptop via internet or wifi To meet these requirements, the spectrometer should include the following functions. • Automated sample transfer. • Automated vacuum control and gas handling. • Automatic sample height adjustment. • Automatic data acquire for wide scan survey spectroscopy and high-resolution narrow scan data. • Automatic data interpretation and quantification • Automated source outgassing		

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14	Sample viewing and alignment	This is essential for small area XPS. The sample navigation tool should support several camera views to facilitate all sample navigation operations. To fulfill this requirement the following sample views are required • A full sample platter view for sample to sample translation. • A real time magnified image of the sample giving a plan view of the sample. This view should have a maximum field of view of 4.5 mm x 3.5 mm or greater. This camera should support digital zoom, providing a magnification of x8. • A higher magnification microscope camera for accurate sample height setting, if required • A rapid mapping capability that can generate fast XPS images over areas of 0.5 mm^2 - ≤2 mm^2, which can be used to define analysis positions.		
15	Operational Software-Data Analysis	The data system should include a comprehensive package of data acquisition and processing software for XPS, including depth profiling, line scans and maps and peak fitting. A built-in database of XPS information and spectra should be included. The data system should include routines for automatic data acquisition and reporting. Simple pasting of data, tables, charts, and images from the data system into other applications must be facilitated.		
16	Vacuum transfer module	The vacuum transfer module must allow samples that have been prepared in an inert environment to be transferred into the spectrometer chamber without exposure to air.		

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17	Computer control	The data system must be capable of controlling and automatically recording the X-ray spot size, all settings of the analyzer and transfer lens, all flood gun settings, and all settings of the ion gun. The data system must have full control of the sample stage for multi-point analysis, azimuthal and compucentric depth profiling, line scans, and maps. Routines should also be included for full automatic spectrometer calibration, X-ray spot size measurement, ion gun alignment, and source conditioning. To complement these routines, position indexed standards (Cu, Ag, Au) must be available at all times in the analysis chamber. The routines should have the capacity to align and prepare standard samples before acquiring data.		
18	PC and monitor	OS: Windows 11 Professional Processor: Intel processor Memory: 32 GB Data storage: 1TB SSD x 2 Media drive: Super multi drive Monitor: 32 inch LCD		
19	Calibration and alignment	The instrument should offer auto calibration for the following functions: • Energy scale linearity • Transmission function • X-ray spot size calibration • Ion gun modes tuning and alignment • Flood gun alignment • Electron lens optimisation • Detector optimization		
20	Bake out of the entire system	The bake-out shielding should be integrated into the system housing. Bakeout can be performed without removing the cables. Bakeout should be hassle free, the system should be baked even with remote access on the data system.		

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21	Recommended spare parts /Consumables	All recommended set of spares and consumables for 3 years operation. (Please provide a complete list of spares with item-wise price)		
22	Training and Installation	Free Of Cost at customer site for 1 week		
23	Warranty	3 years standard		

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Essential items				
24	Vacuum suitcase (Optional)	1 No The vacuum transfer module must allow samples that have been prepared in an inert environment to be transferred into the spectrometer chamber without exposure to air.		
25	Local supplies (Optional)	15 KVA uninterrupted power supply, Compressed air, N_2 gas for venting, Argon Gas with regulator, Stainless Steel Line.		
26	Operator (Optional)	Operator for a period of 3 years		
27	Inverse photoelectron spectroscopy (IPS) (Optional)	Inverse photoelectron spectroscopy (IPS)		
28	REELS (Optional)	Reflected Electron Energy Loss Spectroscopy to provide information about band gaps, defect states.		
2	Secondary anode (Optional)	Cr K alpha		
~~30~~	~~Gas Cluster ion beam source (Optional)~~	~~Gas cluster ion beam source for sputtering samples.~~		
31		The supplier must provide details of installation of the quoted model in India along with purchase order copies issued in last two years.		
32		The supplier should also provide details of the service centres and maximum time to attend to service request.		

Annexure I

Declaration by the Vendor
(to be provided in the following format in their letterhead)

I/We, the undersigned, declare that we have read and reviewed all the terms and conditions of the tender document to which we have affixed our signatures and submitted under proper authorization. We certify that all terms and conditions of the tender document are fully acceptable to us, and we will adhere to the conditions outlined in the tender. We have not included any printed conditions that go beyond the scope of this tender. Furthermore, we certify that neither I/we nor our firm has any objections to signing the contract if we are awarded the opportunity to carry out the work associated with this tender.

Signature:

Date:

Name:

Designation:

On behalf of:

Address: