

## Technical Specifications for Small Angle X-ray diffraction (Scattering) System

### 1.0 Bidder Eligibility Criteria-I

Sl. No	Bidder Eligibility Criteria-I	Complied / Not Complied	Reference Page No.	Remarks, If any
1	The bidder/OEM should have supplied and installed same LCR Meter model quoted at least 5 similar items to IITs, NITs, IISERs, CSIR Labs, Govt. R&D organizations, or universities of international repute outside India in the last 10 years worldwide, PO copies or installation certificates along with contact details of end user need to be submitted as the proof of supply. IIT Madras reserves its right to verify the claims submitted by the bidder and the feedback from the previous customers will be part of technical evaluation.			

### 2.0 Technical Specifications II

S.NO	PARAMETERS	SPECIFICTAIONS	COMPLIED/ NOT COMPLIED	REFERENCE PAGE NO
A scattering unit for analysis of isotropic and anisotropic materials by small and wide angle x-ray scattering (SAXS and WAXS) and also in USAXS (Ultra-Small Angle X-ray Scattering) mode. The instuemtn should have the capability of measuring both in transmission and grazing incidence configuration. The Instrument should be capable of measuring Soft materials like nanoparticle/colloids dispersions, nanopowders, nanocomposites, polymers solutions, surfactants, microemulsions, biomacromolecules, liquid crystal and mesoporous materials.				
<b>I.TECHNICAL SPECIFICATION</b>				
<b>1</b>	X-ray source	A suitable Cu K-alpha microfocus sources to produce a highly monochromatic x-ray beam with high flux density. The beamsize should be 70 micron or less at the source		
<b>2</b>	Flux density of the source	For Cu micorfocus source, the x-ray source must provide a flux more than 400 million ph/s at the sample in high flux setting. The supplier should be able to certify		

		these numbers and provide the certification in the technical bid.		
<b>3</b>	X-ray optics	Any suitable optics such as Graded multilayer optics for collimating the X-ray beam to get a highly intense, adequately monochromatized flux at the sample with sufficiently suppressing K- beta component. The flux of K-beta in the monochromatic beam must be less than 0.02%. The collimating optics preferably should have 3 or more scatterless slits for eliminating the parasitic scattering in the x-ray beam.		
<b>4</b>	Beam stop	A beam stop free system is preferred for high quality measurements at low Q-range. If such an option is not available, a motorized beam stop should be provided and must be an integral part of the system. Automated beam intensity monitoring should be possible. It should also have the facility to vary the size of the beam stop, which should be automatically recognized in the system software.		

<p><b>5</b></p>	<p>Sample Environment</p>	<p>I) Suitable multiple sample holders for solid and powder samples, polymer films, sample holder for liquids, dispersion, emulsion, suspension, macromolecule solution samples should be quoted. The sample holders should have the provision of loading multiple capillaries, and multiple solid samples. Capillary cells of different sizes with diameter of 0.1 mm, 0.2 mm, 0.5 mm, 0.7 mm, 1mm, and 1.7 mm 10 boxes of special glass capillaries and 5 boxes of quartz capillaries must be provided.</p>		
		<p>II) A vacuum compatible high temperature stage for capillaries and thin films with an operating temperature range from -150° C to + 350° C. It must compatible with all modes of measurements such as SAXS, WAXS, GISAXS, GIWAXS, USAXS.</p>		
		<p>III) A shear stage capable of applying controlled shear (steady or oscillatory) in the temperature ranging from ambient to 300° C or above that is compatible with SAXS, WAXS measurements</p>		
		<p>IV) A tensile stage for applying tensile stress on the sample in the range 0 to 20 N with 0.001 N resolution during SAXS and WAXS measurement</p>		

6	Detector	<p>I) Single photon counting two-dimensional (2D) pixel detector with an active detection area of 5600 square mm or larger. The pixel size of the detector must be 100 x 100 square micrometer or smaller. The detector should be capable of measuring in a large Q-range starting from 0.01 nm inverse or lower upto 49 nm inverse or higher with a delta-q of 0.004 nm inverse. The point spread function of the detector must be equal to the physical size of the pixel. The detector shall not have any defective pixels and it should be certified by the company in the technical bid and must be demonstrated during the installation. The detector system must be air cooled and maintenance free.</p>		
		<p>II) An additional two-dimensional pixel detector with an active detection area of 1200 square mm or larger should be provided for WAXS measurements. The pixel size of the detector must be 100 x 100 square micrometer or smaller. It should be capable of collecting scattering data for scattering angle, <math>2\theta = 75^\circ</math> or higher.</p>		

7	Beam path requirements and sample stage movement	<p>I) The detector or the sample must be movable. It is preferred if the movement is fully motorized and the system should have the capability to vary the sample to detector distance continuously. The SAXS measurement should be performed under vacuum with suitable vacuum pump which should maintain the vacuum better than 1 mbar.</p>		
		<p>II) A camera must be provided to monitor the detector/sample positions while changing the mode of measurement from SAXS to WAXS and viceversa.</p>		
		<p>III) Should be capable of measuring SAXS data while maintaining the sample environment in air without compromising its performance.</p>		
		<p>IV) The sample stage should be capable of moving along two axes perpendicular to the x-ray beam propagation axis. A motorized sample stage for easy sample loading and mounting. The sample stage should be movable by more than 50 mm in the horizontal and 50 mm in the vertical directions with 0.001 mm step size for alignment.</p>		
8	Grazing-incidence small angle x-ray scattering (GISAXS)	<p>GISAXS module: Sample stage to perform GISAXS measurements with XYZ translation movement precision accuracy of +/- 1 um and angular positioning accuracy of +/- 0.001° should be offered. Omega stage, on top of Z stage</p>		

		(rotation around X) $\Omega$ : from $-3^\circ$ up to $+5^\circ$ , precision = $1e-4^\circ$ or better.		
<b>9</b>	Ultra-small angle x-ray scattering (USAXS)	Suitable optics such as a retractable crystal monochromator together with an analyzer should be provided to extend data collection by approximately 1 order further in low-Q (down to $\leq 0.0015$ inverse nm). The movement of the optics module should be fully computer controlled.		
<b>10</b>	Data Analysis Software	<p>The Software should comprise of powerful image processing and data evaluation software, which effectively speeds up the processing of SAXS and WAXS raw data. Automatic generation of data in absolute intensity is desirable. Advanced data interpretation software should be provided capable of performing operations such as profile averaging, background/buffer subtraction, radius of gyration calculations, determination of particle shape and structure, calculation and generation of pair-distance distribution plots, with different inbuilt models etc. Software must include peak finding module, form factor fitting, particle size distribution, specific surface, crystallinity calculation, lamellar structure determination .</p> <p>A toolbox for advanced 2D processing for anisotropic SAXS or GISAXS/ WAXS data should be included. Global fitting software for X-ray reflectivity should also be included. Software license for at least 10 PCs.</p>		

11	Radiation Safety	The system should be designed to meet safety radiation of 1 $\mu$ SV/hr or less under regular operation. System should also be equipped with safety sensors, which activates automatically under unsafe system operation.		
12	Control and operation	<p>I. The system should be PC controlled and software capable of automated instrument control should be offered.</p> <p>II. Suitable PC for data acquisition and data analysis to be quoted. Specifications: Computer should be compatible with the system and capable of handling the quoted software and hardware. Work station should be latest branded desktop, i7 or higher processor, DVD- RW drive, HDD 2TB or better, 32 GB DDR RAM, 27 inch LED Monitor with, Windows operating system along with one coloured laser printer and one b/w laser printer, Separate similar computer (to be networked with primary computer) for data analysis.</p>		
13	Warranty	Comprehensive warranty on all hardware including x-ray tubes and detectors for 5 years. The warranty should include free replacement of important consumable such as x-ray source. Within the warranty time period the instrument downtime should not be more than a month, otherwise the comprehensive warranty time would be increased by a month for every 1 week delay.		

<b>II. General Requirements</b>			
<b>1</b>	Price should be quoted in CIF and should be inclusive of installation and training		
<b>2</b>	A complete set of installation CDs/DVDs to be provided. Also set of manuals including service and operational manuals and required hardware and software documents should be provided in the form of hard copy as well as soft copy.		
<b>3</b>	The complete system should offer with the confirmation of availability of spares for 10 years and quoted model should be latest model and an original certificate from manufacturer should be attached with the bid.		
<b>4</b>	AMC- 2 years optional warranty. (Will not be considered for price bid evaluation)		