

Name of the Equipment: High Resolution X-ray Diffractometer for Thin Film and Powder Analysis

Required Quantity: 1 No.

Technical Requirements and Specifications of “High Resolution X-ray Diffractometer for Thin Film and Powder Analysis”:

High Resolution X-ray Diffractometer:

Capable of performing high resolution structural characterization on bulk, powder and thin films, with the following specifications:

1 X-rayGenerator:

- i) Output Power $\geq 6\text{kW}$
- ii) Maximum voltage $\geq 40\text{kV}$
- iii) Voltage increment $\leq 1\text{kV}$
- iv) Maximum current $\geq 150\text{mA}$
- v) Current increment $\leq 1\text{mA}$
- vi) Stability: $\pm 0.01\%$ or better against $\pm 10\%$ voltage fluctuation
- vii) Mode of operation: Automatic and software controlled
- viii) Safety: Overload limit setting, Automatic ageing of X-ray tube and X-ray tube protection against under voltage, over load, over voltage, over current and/or failure of water supply. Should have door interlock safety mechanism which allows the generation of x-rays only when the door is closed. Water Cooled Chiller of reputed make for the above.

2 X-rayTarget:

Cu (Rotating Anode) with appropriate filter and Parabolic Multigraded mirror in the incident beam for making the beam parallel

3 Goniometer

The goniometer should be Vertically or Horizontally mounted. It should have the capability of carrying out the complete analysis of bulk, powder and thin films (4 circle geometry or similar) samples. All accessories required for reciprocal space mapping with appropriate software should be quoted. The system should allow residual stress and pole figure analysis of metallic superalloys. Should have automatic alignment when the mode of operation is changed using optical encoders.

- i) Type: Theta – Theta ($\theta - \theta$) or Theta- 2 Theta ($\theta - 2\theta$)
- ii) 2θ range – 0 to 160 degrees (deg.) or better
- iii) Minimum step size: 0.0001 deg. or smaller
- iv) Angle reproducibility: 0.0001 deg. or smaller
- v) Resolution: 0.05 deg. or better
- vi) 4-axis attachment for analysis of thin/textured films
- vii) Sample height alignment unit with Sample Up/down mechanism

4 In-plane arrangement for RSM/GID in goniometer

- i) Scanning axis (driving method): Horizontal $2\theta\chi$ (Two-theta-Chi) perpendicular to the θ/θ diffraction plane (Pulse motor drive)
- ii) Scanning speed: $2\theta\chi$ independent 0.01 ~ 20 deg./min or more
- iii) Step width: $2\theta\chi$ independent- 0.002 deg. or less
- iv) Scanning range: 0 – 100 deg. ($2\theta\chi$) or more

5 Thin film attachment

- i) Should allow XRD of multilayer thin films. Should work in both reflection and transmission mode.
- ii) Phi (ϕ) Axis- Operating range -360 to +360 deg. with minimum 0.005 deg. step or better
- iii) Chi (χ) Axis- Operating range -5 to 92 deg. with minimum 0.002 deg. step or better
- iv) Z Axis- Operational Range -6 to +1 mm range with minimum 0.001 mm step or better
- v) Thin Film Slit
- vi) Should allow high resolution and high intensity X-ray reflectivity, in-plane GID, 2D GISAXS and 2D WAXS measurements.
- vii) Appropriate thin film acquisition and analysis software for Reflectivity, RSM, In Plane analysis.

6 Detector

One Dimensional (1D) Linear Detector: Additionally a multistrip solid state 1D detector which can work in both 0D and 1D model. The pixel size here should be equal to or less than 75 microns. The detector should have Fluorescence suppression mode built in.

7 Slits

- i) Computer controlled automatic Slits: Should include divergence, scattering, receiving and height slits and Slit Exchanger system with automatic alignment and control with automatic systematic error correction. The arrangement should facilitate small angle (~ 0.5 degree) measurements.
- ii) All the relevant slits including slits for high resolution focusing method (all slits used in incident beam optics and diffracted beam optics including Incident and receiving Soller slits) should be mentioned
- iii) Two bounce monochromators both at primary and secondary beam sides. For parallel beam optics:
Ge (220) two bounce crystal for Cu K_{α} in the incident path with the divergence of the exit beam should be below 0.01 degree. All crystals should have motor controlled rotation adjustments.

8 Accessories

- i) **Automatic Attenuators:** Automatic attenuators should be available to protect the detector from direct beam
- ii) **Sample holders:** Flat sample stage for solid, powder and polycrystalline thin film sample with 20 numbers of rectangular sample holders, Zero Background sample holder (at least 2 in number).
Sample holders for gels, liquids, suspensions, nanocomposites and any other kind of sample that can be measured
- iii) **NIST Standard samples:** NIST standard samples for all measurements possible with the diffractometer should be provided for calibration purposes
- iv) Any other **essential spares and accessories** as required

9 Future Upgradeability

System in its present form should be upgradable in future to include other modules and optional attachments from time to time. The basic design should not become obsolete for at least 10 years of operation. Spare parts, accessories, and service should be

made available for at least 10 years of operation.

10 Standard measurement, data processing and analysis software and database

The software should be able to perform

- i) X-Ray Generator Operation.
- ii) Manual Measurement.
- iii) Auto setting (with counting loss correction function).
- iv) Standard measurement.
- v) Automatic Alignment.
- vi) System conditioning setting (Change configurations).
- vii) Measuring Monitor and ASCII Output.
- viii) Determine which optical modules are best for an application, and perform automatic alignment, setup and measurement. Should deliver a completely automated measurement sequence.
- ix) Data processing software: Academic License should be clearly specified in the tender document
- x) Analysis Software: Should allow both qualitative and comprehensive analysis like **Rietveld refinement**, Should include (but not limited to) lattice constants, Crystallinity, Indexing. The details of the software functionalities should be clearly specified in the tender document

11 Computers and Printer

Computer with following specification or better should be quoted:

Intel core i7 processor, DVD-RW drive, 16GB or better RAM, 2TB HDD, 23 inch LED monitor, Windows 10 Software.

Laser jet Branded Printer

12 Water Chiller and UPS

- i) Quote for appropriate reputed brand compact chiller with adequate capacity for the XRD system.
- ii) A 40 kVA UPS of reputed brand capable of providing minimum 30 minutes back-up along with isolation transformer of reputed make.
- iii) **NIST Standard samples**: NIST standard samples for all measurements possible with the diffractometer should be provided for calibration purposes
- iv) Any other **essential spares and accessories** as required

13 Future Upgradeability

System in its present form should be upgradable in future to include other modules and optional attachments from time to time. The basic design should not become obsolete for at least 10 years of operation. Spare parts, accessories, and service should be made available for at least 10 years of operation.

14 The vendor should have at least 5 installations in India.

15 Warranty period: 36 months from the day of installation.