ANNEXURE I

TECHNICAL SPECIFICATIONS FOR
TRANSMISSION ELECTRON MICROSCOPE (TEM)
SUITABLE TO INVESTIGATE APT SAMPLES
AS A BUY BACK FOR THE EXISTING TEM (Tecnai G2 twin (T12))

The TEM must be able to:

A. Image needle form of samples suitable for atom probe tomography (APT) both in transmission mode as well as in scanning transmission mode.
B. Support full remote operation: Automatic aperture changing system in combination with the camera support controls and stage rotation in remote mode.
C. Map chemical constituents and quantification of the same using energy dispersive X-ray spectroscopy (EDX) consisting of 2 or more semi-conductor detectors.
D. Image samples in multiple tilt angles.

The offer should be with rebate (buy back) for the old Tecnai G2 twin (T12) and also offer without rebate (buy back) for the old Tecnai G2 twin (T12). The existing TEM Tecnai G2 twin (T12) details are given in the annexure.

DETAILED SPECIFICATIONS

S.No.	Item	**Description**
1.	Accelerating Voltage	200 kV - user changeable from 20 kV - 200 kV without intervention of a service engineer
2.	Electron Source	Schottky field emitter with Probe current ≥1.5nA/1nm probe with maximum beam current ≥ 50nA at 200kV
3.	Resolution	Information limit should be 0.12 nm or less TEM Point resolution should be 0.25 nm or less The STEM resolution should be less than 0.16 nm.
4.	Magnification	TEM Magnification: Range 50x to 1Mx or higher STEM Magnification: Range 290x to 330Mx or higher
5.	Lens System	System consisting of condenser lens, objective lens, diffraction, intermediate and projection lenses
6.	Objective Lens	Analytical objective lens with constant power. The objective lens should enable the use of various in-situ holders and large angle double-tilt holders for analytical microscopy. The pole piece design should allow the specimen to remain at the Eucentric position for all operating modes and should be able to integrate the EDS system. It is preferred to have a symmetrical objective lens design.
7.	Specimen chamber	Goniometer tilt should be +/-80 degrees or higher Minimum specimen tilt angle with a low background double tilt holder should be (α/β) ±35° /±30 ° X movement range – 2 mm in total or more Y movement range – 2 mm in total or more Z movement range – 0.70 mm in total or more Specimen grid size 3 mm Microscope should have a fully Eucentric goniometer with all 5 axis motorized. TEM stage should be stable with drift 0.5 nm/min or better

8.	Vacuum System	• Microscope should have oil free vacuum system • FEG gun vacuum should be $\leq 5x10^{-6}$ Pa • TEM column vacuum should be $\leq 2x10^{-5}$ Pa
9.	STEM detector	1. STEM should be consisting of BF, DF and HAADF detectors. 2. Possibility to include Precision Electron Diffraction system.
10.	Recording System: CMOS Camera	1. Bottom Mounted, EELS compatible high-resolution CMOS camera of minimum 4k x 4k pixel. 2. Camera speed should be 25 fps or higher. 3. Camera dynamic range should be 16 bit. 4. Camera should be usable at 20-200kV HT range. 5. Camera should be retractable and EELS compatible. TEM maximum Magnification on camera plane should be at least 1.0Mx or more
11.	Equipment software	Full software package for TEM control, data acquisition, analysis and display. • Software should be capable of image processing, video recording and clipping, EDX analysis; electron interaction based imaging and selected area electron diffraction analysis. All future up gradation of software should be supplied free of cost with License.
12.	TEM Standard	Au/any other standard sample for TEM resolution check.
13.	Future Up gradation	TEM should be upgradable for 3D-tomography, EELS etc. in future
14.	EDS Detector	• The EDS must incorporate two or more silicon Drift detectors of area 60 mm^2 or higher for light element sensitivity. The detectors must be placed in such a way that the specimen is surrounded by all the in-column detectors and therefore provide tilt independent performance of the detector. • The hardware and software control capabilities such as small pixel dwell time, automatic collection of element maps, auto-drift correction during acquisition and automatic X-ray detector protection mechanism must be available. • X-ray detector must have an energy resolution less than or equal to 140 eV at Manganese Kα and 100,000 cps and capability to detect elements with atomic number >5 (i.e. from B onwards). • Application software for X-ray spectra acquisition and analysis must include full qualitative and quantitative analysis and thin film matrix correction algorithms. • The EDS detector solid angle should be ≥ 0.45 srad at all tilt angles. • EDS maximum output count rate is more than 140,000 cps (or better) and a typical peak to background ratio of 4000 (or better). • EDS calibration standards of Mn K must be included. • An offline copy of the EDS software must be included for data processing and training purposes.
15.	EDS Software	Windows/PC based software compatible with TEM operating software. • Quantitative Elemental analysis and elemental mapping capability.

		• The system software should have facility to track and correct the image shift during longer acquisition time required for critical mapping applications. • Capability to add, subtract and otherwise manipulate elemental colours in images. • Calibration should be software controlled. • All future up gradation of software should be supplied free of cost.
16.	Enclosure	TEM Should have Active functional enclosure that controls and/or neutralizes all external disturbances for best operational performance.
17.	Remote operation	S(T)EM imaging should be able to be operated remotely to avoid any disturbances because of operator or environmental issues.
18.	Essential ancillary equipment for break free operation	All essential ancillary equipment such as chiller, compressor, vibration isolation system, EMI active shielding system etc. should be quoted along with TEM-EDS. Suitable UPS for 1 hour of back up.
19.	Mandatory Buy-back option	Buy-back offer for the existing Tecnai G2 Sprit Twin TEM (working condition) should be provided. More details about the TEM are provided in the attached annexure.
20.	Spares and Consumables Spare-parts Kit, and consumables	• A first-level maintenance kit, a list of items should be provided with the quote. • All essential spare parts and necessary consumables required for down time free operation of the equipment (TEM, EDX, CCD etc.) for three years from the date of installation should be quoted along with TEM-EDS. • The vendor has to guarantee that all the spares parts for the offered TEM and attachments will be available for at least next 10 years.
21.	Sample holder	Holder compatible to loading Atom Probe Tomography samples - 1 number High-visibility Low-background Double-tilt Holder- 1 number
22.	Manuals and CDs	One set of printed operation and maintenance and service manuals in English language.
23.	Installation, Warranty, Training and Services	• Pre-installation requirements such as room size, required power rating, utility requirements – chiller, gases (argon, N_2), AC etc. are to be clearly mentioned. • Site inspection and qualification must be performed by vendor's authorized representative, well in advance of system delivery. • Installation, complete interfacing of the system with its subsystems, and commissioning is to be carried out by the vendor's factory-trained engineers, followed by a demonstration of the system's performance fully to the user's satisfaction. • One-year comprehensive warranty from the date of installation on the complete system, including all the subsystems. • In addition, 3 year comprehensive AMC need to be included in the quote. Warranty should cover: • All parts including accessories and labor. • Free maintenance and service. • Regular up-gradation of softwares.

		• All power supplies must conform to the mains supply: 230 ±10 volts, 50 Hz. • A training program of at least 01 weeks free of cost by the vendor's trained engineers at site. • Compliance statement to each item of this document to be provided along with the technical bid

Mandatory requirement:

Testing of the samples supplied by us to validate the specifications with respect to APT sample compatibility. The above testing process is to be made accessible for the end user in person or through skype or similar web based application. It may be noted that the decision to open the financial bids will be based on the test results.

NOTE / Pre-Qualification criteria:

A) Equipment offered must be a model from the current serial production range of the manufacturer. Offer should be supported with printed catalogue / depiction on company website.
B) The local vendor of OEM must have supplied at least 10 TEMs to IITs, IISERs and other Govt. of India organizations. Please attach a reference list of supplies in last 3 years with contact details (Name, Phone, email address) of users.
C) The company or companies (for combined quotations) should be original equipment manufacturers (OEMs) of the TEM-EDS systems. Please attach exclusive authorization certificate(s) specific for this tender with quote without which bid will be rejected.
D) The price quoted should be for EX WORKS and CIP.

Annexure:
The technical details and the working condition of Tecnai G2 Spirit TWIN TEM is provided below which can be examined based on prior request for a suitable buy-back offer estimation. The microscope belongs to the 2017 model of manufacture and was installed at IIT Madras on July 2018. It is fully operational from July 2018 until now.

S. No.	Description
1	Tecnai G2 Spirit TWIN The core instrument (Tecnai G2 Spirit TWIN) includes • Workstation +19" LCD monitor • Digital camera embedding • Automation software: AutoAdjust and AutoGun
2	Gatan US1000xP-P camera for 300kv
3	SA Aperture system
4	Compressor 220v, 50/60Hz
5	Cooling water unit 50Hz, Air temperature<43°C
6	CompuStage single-tilt Holder

1. Condition of Tecnai G2 twin (T12): **Good working condition**
2. Location: **IIT Madras, HSB – Central Microscopy Facility.**
3. Mode of handing over: **Ex. IITM**