ANNEXURE: I

TECHNICAL BID PROFORMA

Item Name: Room temperature scanned NV probe-based imaging system

1.0 Bidder Eligibility Criteria:

I	**Bidder Eligibility Criteria-I (Public Procurement – Preference to Make in India)**	**Class I / Class II**	**Local Content value**	**Reference, Page No.**
I	Only 'Class-I local suppliers' and 'Class-II local suppliers', as defined under DIPP, MoCI Order No. P-45021/2/2017-PP (BE II) dated 16th September 2020 and other subsequent orders issued therein.			
2.0	**Bidder Eligibility Criteria-II**	**Compliance (Yes/No)**	**Reference Page No.**	**Remarks, If any**
1	At least 5 similar systems of the same manufacturer should have been supplied by the vendor in worldwide within the last 3 years.			

3.0 Technical Compliance:

S.No	Technical characteristics	Requirement	Complied/ Not Complied	Reference Page No
1.	**Imaging modes** (Further details/ requirements for each mode provided below)	• Conventional AFM with Akiyama tuning fork probes • Wide field imaging • Confocal mapping • Scanned NV magnetometry • Scanning magneto-optic Kerr effect (MOKE) mode		
2.	**Geometry**	Standard operation should be with objective on top with cantilever and sample below it vertically. The system should also be compatible with inverted optical geometry that allows the NVs below the sample to be illuminated.		
Sample stage and enclosure				
3.	Sample stage size	At least 40 x 40 mm² and allow for samples/holders of thickness up to 15 mm (or more).		
4.	Drift	The system should be capable of achieving AFM drift of < 2 nm/h in all directions. Suitable enclosure for temperature and acoustic isolation should be provided and should provide temperature stability of 0.1 C or better over 5 hrs at least.		
5.	Compatibility with currents and magnetic field	It should be compatible with magnetic field module described below. It should also be compatible with PCB/electronic boards to apply currents/microwave/RF to the sample.		
Specs for AFM mode, sample stage and scanning spec				
6.	AFM mode support	• AMF should be based on Akiyama Tuning fork that are compatible with scanned NV tips. • At least AFM topography in fixed tip-sample separation mode (two pass mode) and fixed height mode		

7.	Coarse sample positioning system	Closed loop automated position system with a range of 5 mm (or more) range in all three (X, Y, Z) and a resolution of 1 micron or better		
8.	AFM scan area	Scan range of 80 microns or more in horizontal direction and 10 microns or more in vertical direction (the vibration direction)		
9.	Scan resolution/spatial noise	< 0.2 nm in X and Y (in 100 Hz bandwidth) and < 0.2 nm in Z (bandwidth 1 kHz)		
10.	AFM head tip holder	The holder should be compatible with NV probes having integrated MW line		
Specs for Wide field scanning mode				
11.	Wide field Imaging system	Two wide field options (with separate CCD cameras) should be provided to enable finding areas of interest in the sample and position the cantilever and the microwave antenna relative to the sample: 1) through the objective and 2) from the side to view cantilever and antenna.		
12.	Field of view	≥ 150 μm (longer dimension) for objective camera and ≥ 2 mm for side view camera		
13.	Spatial resolution of camera image	Through the objective imaging: 1 micron or better Side view: 10 microns or better		
14.	Camera specs	≥ 5 MP resolution, full color		
Confocal imaging mode specs				
15.	Spatial Resolution	The confocal mapping should achieve diffraction limited (for the objective listed below) confocal mapping		
16.	Confocal Scanning mode	Laser scanning using galvo mirrors for fast scanning		
17.	Range and resolution of scanning hardware	Range ≥ 100 micron diameter, resolution: better than 75 nm in XY (horizontal), Z (vertical) better than 0.5 nm		
18.	Magnification	Magnification: 40X-100X Numerical Aperture: ≥ 0.7 with optical transmission ≥ 0.85 in the NV Center emission band (650 - 800nm)		
19.	Focus	Piezo controlled 1 nm or better		
20.	excitation laser	• Wavelength: 515 nm – 560 nm with a maximum power >10mW, variable. • Software tunable output power, • Direct Digital modulation with >100 MHz, 2.5 ns rise/fall time		
21.	Detector	System should be provided with at least one single photon detection with the following specs: • Dark counts: < 250Hz • Dead time: < 35 ns, • count rate of up to 20 Mcts/s • quantum efficiency of > 60 % in 650-670 nm range		
Scanned NV magnetometry specs				
22.	CW Magnetometry imaging modes	At least these modes should be provided: CW-ODMR, Quenching, Iso-B,		
23.	Microwave generator + amplifier	A variable MW source from 0.5 GHz to 6 GHz, with frequency resolution of better than 1 Hz. An amplifier suitable for this entire frequency range must be provided with a maximum output power exceeding 45dBm. Software control for setting the power must be provided.		
24.	Microwave antenna for ODMR microwave field and it positioning system	• A broadband antenna (covering the generator and amplifier range) must be provided. • A manual position stage to bring it close to the sample must also be provided. • The stage should be a XYZ manual stage with		

		travel range of 4x4x4mm³, and a resolution of < 1 μm.		
25.	CW Scanning speed	Standard mode: 100x100 pixels: 3 h or better Fast mode: 100x100 pixels: less than 5 mins in full B scanning mode		
26.	CW Sensitivity	Better than 1 μT/√ Hz, **to be demonstrated**		
27.	Pulsed ODMR	The system should provide pulsed ODMR capabilities, including all the necessary hardware and software. As installed system should at least be able perform Rabi oscillations, relaxation time (T1), Spin-Echo, CPMG, XY-8 protocols in scanning mode.		
28.	Microwave and optical pulses	System should be capable of producing microwave pulses as needed for pulsed ODMR with minimum pulse width of 5 ns or longer. System should be capable of producing optical pulses of 10s of nanosecond to milliseconds as needed to perform the pulsed sequences.		
29.	Electronics for pulsed ODMR control	System should come with the necessary electronics such as AWG, IQ mixers and switches etc. as needed to perform pulsed ODMR listed above and produce the pulses as listed above. AWG specs: 16 bit, ≥ 2 analog channels, >1 GHz sampling frequency.		
Scanned MOKE mode specs				
30.	Scanning MOKE mode	A scanning MOKE mode which can be operated simultaneously with the scanning NV mode should be provided. Independent measurement of for horizontal and vertical polarizations should be included, along with the needed optics and detectors.		
31.	MOKE spatial resolution	It should be diffraction limited		
32.	Sensitivity of MOKE	Angular resolution better than 1 mrad		
Magnetic field module specs				
33.	Module	• The vendor should supply an electromagnet compatible with the sample stage and not hinder any imaging capabilities. • It should be capable of producing vector magnetic field ≥ 75 mT in any direction. • Field change speed of 1 sec or faster. • All the required power supplies and electronics and cables must be provided. • Software control of the field must be provided.		
AFM and NV probes				
34.	Standard AFM Akiyama probes	5 standard AFM Akiyama quartz tuning fork cantilevers (similar to the scanned NV probes) must be provided.		
35.	Scanned NV-AFM probe tips	The following NV probes must be provided: 100-oriented probes: 12 nos. 110-oriented probes: 3 nos. 111-oriented probes: 2 nos. Probes with no NV (for practising): 3 nos.		
36.	NV probe quality	For at least 6 of the 100 tips and for all of 110 and 111 probes hyperfine splitting should be visible, with ODMR contrast ≥ 20 % and photon count rate of ≥ 350 kcts/s		
37.	NV depth	Average NV depth in the tip from the surface ~15-20 nm.		
NV Pillar Samples				
38.	pillar arrays	at least 4 membranes with pillar arrays of size 1x1 mm with 20um thickness		
39.	Orientation	100 oriented NVs		

40.	NV density	Average NV density in the range of 1-20 NV per pillar (to be decided before fabrication by the customer)		
41.	Pillar size and separation	200 nm- 1 micron (to be decided by the customer before fabrication)		
42.	**Control computer**	Windows 10 Pro. / 64 Bit, i7-6700K, / 64 GB RAM DDR4 / 2 TB SSD / 4 TG Hard Drive or better configuration		
43.	**Quantum Control Software**	Integrated software control allowing operation of all the modes mentioned above: AFM, confocal, Scanned NV and MOKE, wide field. Ability to add customer scripts for custom measurement protocols.		
Installation and approval criteria				
44.	installation	The item must be installed on site by the vendor at IITM. Successful operation of all the modes listed above must demonstrated.		
45.	Specialized sample demo	Validation of the scanning NV protocols should be demonstrated on a selection of samples, including at least $BiFeO_3$. Magnetic signal to noise ratio > 5 should be achieved. Additionally, NV scanning speed increase of 100X (relative to the standard mode) should be demonstrated, preferably on a skyrmion sample, to validate the fast scan mode.		
Other Terms and Conditions				
46.	Training	At least 2 days on-site training by an expert for three (3) people on use of control and data processing software.		
47.	Documentation	Both hard copies & digital version of the manuals and documentations should be provided in English.		
48.	Warranty	At least two (2) years on site, including parts, work and travel should be provided		
49.	Quick service	In the event of a machine failure, remote control and diagnosis of the repairs can be carried out in advance within one week of report.		

SIGNATURE OF BIDDER ALONG WITH SEAL OF THE COMPANY WITH DATE