IISc/SSCU/2019/PPMS01

Tender Notification for the Procurement of a Physical Property Measurement System (Last Date for Submission: Tuesday, June 4th 2019)

Kindly send your best quotation for a Physical Property Measurement System with the following technical specifications on C.I.P. Bangalore basis (by ***Air Freight*** only). Your quotation should clearly indicate the terms of delivery, delivery schedule, estimated delivery date, and payment terms. The tender should be submitted in two separate sealed envelopes - one containing the technical bid and the other containing the commercial bid, both of which should reach us, duly signed on or before 1700 hours on Tuesday, 4th June 2019.

The bids should be addressed to:

The Chairman,
Solid State and Structural Chemistry Unit
Indian Institute of Science (IISc)
Bengaluru, India - 560012.

The sealed bids should be sent to:

Naga Phani B Aetukuri
Solid State and Structural Chemistry Unit
Indian Institute of Science (IISc)
Bengaluru, India - 560012.
Ph: +91-80-2293-3534
email: phani@iisc.ac.in

Please enclose a compliance statement along with the technical bid.

Technical Specifications for Physical Property Measurement System

1. Broad System Requirements and Usage

We are seeking to procure a state-of-the-art Physical Property Measurement System (PPMS) to be part of the departmental characterization facility. Therefore, the following technical criteria are to be met by any PPMS being quoted under this tender notice:

1.1. The PPMS equipment being quoted should be multi-user friendly with an easy to use software interface, modular hardware design that allows for rapid user training and should also be easy to change from one measurement mode to another with relative ease. For example, the change from a magnetic property measurement mode to an electrical transport measurement option should be relatively easy so that our students can set-up measurements and collect reliable and reproducible experimental data.

1.2. Our faculty members work in diverse areas of research at the intersection of fundamental chemistry, physics and new materials synthesis and characterization. Therefore, the PPMS being quoted should be an advanced PPMS system that can go far beyond the basic physical property measurements. For example, the PPMS should, in addition to the basic magnetic property measurements, electrical property measurements and thermal property measurements, be capable of measuring magnetization in samples with low magnetic moment (<0.1 micro emu) using torque Magnetometry; should be customizable for Ferromagnetic Resonance (FMR) Measurements on thin magnetic films; and be able to perform optical and Raman measurements with suitable accessories.

1.3. In addition, the system being quoted should have a modular design providing the flexibility to add any of the above capabilities or other physical property measurement techniques either at the time of procurement or at a later date.

2. PPMS Base System Requirements

2.1. The system being quoted should be a closed-loop cryo-cooling system without the need for liquid helium and/or nitrogen. Neither liquid helium nor liquid nitrogen should be needed at any time.

2.2. Cryo-cooling should be based on a pulse tube cryocooler so that noise associated with mechanical vibrations can be minimized. A two-stage pulse tube cryocooler is preferred for efficient and faster cooling. Mechanical vibrations should be low enough to attain all of the mentioned specifications in later sections.

2.3. The system should not use recirculation of any remotely located source of liquid helium as a refrigerant.

2.4. Any capillaries, needle valve system or other similar systems used for refrigerant injection into the sample space for cooling, should be serviceable on field, if ever they get clogged with moisture. Such service should be possible by trained users. If a service personnel is required, the total time required for such a service before the machine can be used should be clearly mentioned. Since, this is a machine for a general user facility, service times of less than 2 days are required. Supporting documentation for such service must be provided.

2.5. A sample space with a bore diameter of at least 1 inch is required.
2.6. Compatible sample transferring system and sample holders (or pucks) with necessary electrical connections must be included. Such sample holders should be designed to have a good thermal uniformity across the sample over the measurement temperature range of 1.8 K to 400 K.
2.7. The sample chamber should be sealed to retain either vacuum or an inert gas environment during measurements.
2.8. Necessary vacuum and gas purging system should be integral to the base system and their operations should have been fully automated such that minimum user intervention is required. A high vacuum system, with for example a cryo-pumping option, should be included. The high vacuum system should be able to achieve a vacuum of less than 10^{-5} Torr.
2.9. All vacuum pumps or any other pumps used for the purpose in 2.8 should be 'dry' – that is they should not use any oil-based pumping systems.
2.10. All communications on the system must either use a Universal Serial Bus (USB), Controller Area Network (CAN) or similar high speed and high-fidelity communications protocols. If a GPIB based communication protocol is employed, the tenderer must provide supporting documentation demonstrating that the bit-rates and error-rates in GPIB do not in any way compromise the speed and reliability of data acquisition.
2.11. Necessary software for performing all measurements (the measurements requested in this tender and measurements to be acquired through possible future upgrades) should be included. The software should also enable sample loading, unloading, and provide system status – magnet temperature, sample temperature, system status such as measurement in progress or idle.
2.12. All system operations including temperature changes and magnetic field changes should be completely remotely controllable using the software provided.
2.13. A provision for having different software access levels such as a user level, engineer or expert level is preferable.
2.14. The software should allow for fully automated measurements and should minimize user intervention. This is essential since the instrument will be housed in a general user facility.
2.15. Furthermore, communications to and data acquisition from the instrument should be possible with user-customizable programs such as Labview. Supporting software modules in Labview must also be provided for any customized measurements that the user wishes to set-up. Such programs should enable both magnetic field and temperature control and full data acquisition capabilities of the software provided with the system.
2.16. A superconducting magnet, with the following specifications, should be included in the base system:
    2.16.1. A longitudinal magnetic field (along the axis of the sample bore) of ± 9 tesla or greater with a magnet charge time of less than 10 minutes for 0 to 9 tesla is required (*please provide data*).
    2.16.2. Magnetic field stability of better than 5 ppm/hour (*please provide data*).
    2.16.3. Field homogeneity of better than 100 ppm over an on-axis distance of at least 1 inch is required (*please provide data*).
    2.16.4. Magnet electronics and power supply should be fully interlocked so that the magnet is fully protected in case of a failure of other supporting systems such as the cryo-cooler.

2.16.5. There should be a suitable built-in magnetic shield so that the stray fields should be less than 5 gauss at a distance of 30 cm from the surface of the system when the magnet is fully charged to 9 tesla. This is important both from a safety stand-point and from ensuring that the stray magnetic fields do not interfere with other measurements in the proximity of the system. *(please provide data).*

2.16.6. The magnet charging or control modes should be completely software integrated. At the least, there should be linear, oscillating and no overshoot modes. Please specify the field overshoot in the 'no overshoot' mode for field strengths of 1, 3 and 9 tesla.

2.16.7. Magnet control should be fully software-integrated.

2.16.8. Magnet's health and status monitoring and protection from accidental quenches should all be handled through internal electronics or software. This is absolutely essential as the system is intended for a general user facility.

2.16.9. The cooling of the magnet should be efficient. After a service warm up, the magnet should cool down to its operating temperature in less than 16 hours. This is essential to ensure that the downtime of the system is minimized. Please provide the time needed for a full system cool down. Further, provide the approximate helium gas usage for such a full cool down. This data is important to determine the resources (time and money) required for bringing the system back up after a service warm up.

2.17. A fully automated variable temperature option should be integral to the base system. The variable temperature option should meet the following specifications:

2.17.1. The cryostat assembly should enable fast, efficient and continuous cool down from 400 K to 1.8 K or warm-up from a temperature of from 1.8 K to 400 K. Please provide approximate helium gas usage for sample cool down from 400 K to 1.8 K. The time required for a cool down from 400 K to 1.8 K or a warm up from 1.8 K to 400 K should both be less than 1 hour. Please provide supporting data.

2.17.2. Temperature changes to the sample – either cool down or warm up should be fully automated with the system software.

2.17.3. The system should enable cooling or heating of the sample at any magnetic field; the system should be able to hold the measurement temperature to within 0.1% in the temperature range of 1.8 K to 20 K under magnetic fields of up to 9 T and to within 0.05% at temperatures of 20 K to 400 K. Please provide temperature stability data at 1.8 K at a magnetic field of 9 tesla. The data should have been collected as prescribed below: a) Set the sample temperature to 1.8 K at 0 tesla magnetic field (nominally zero field); b) stabilize the sample temperature at 1.8 K for 10 min; c) continuously ramp the magnetic field to 9 tesla while recording the temperature. Please provide the recorded data in a temperature versus time format, clearly indicating the three steps above.

2.17.4. A high fidelity PID-Temperature control should be fully integrated with the base system and associated software.

2.17.5. Necessary thermometers and heaters for temperature control should be provided with the base system.

3. Magnetic Property Measurement Options to be included

3.1. A vibrating sample magnetometer option that can perform both and AC and DC magnetic property measurements should be included in the quotation.

3.2. The system should be capable of measuring over the temperature range of 1.8 K to 400 K in magnetic fields ranging from – 9 to +9 tesla. Please provide data of DC magnetization versus temperature (during both warm up and cool down) at magnetic fields of 1, 3, and 9 tesla on a sample with a total magnetization of 10 micro emu or less. The data should have been collected at 1 second or smaller averaging time. Shorter averaging times are required to speed up data acquisition which is essential for a general user facility such as this.

3.3. The system should provide for temperature stability during a DC magnetization (M) versus magnetic field (H) measurement. Please provide data of M-H curves collected at 1.8 K, 10 K, 300 K and 400 K on a sample with a total magnetization of 10 micro emu or less.

3.4. The RMS sensitivity in zero field should be at least 0.5 micro emu and at any magnetic field other than zero should be at least 5 micro emu.

3.5. Brass and quartz sample holders for sample mounting should be included. The sample holders must be suitable for powders, pellets and thin films.

3.6. Sample preparation/alignment box with a mirror should be included.

3.7. VSM coil set bore size should be 6 mm or larger.

3.8. The VSM oscillation frequency should be tunable from 10 Hz to 50 Hz over the entire temperature range.

3.9. VSM measurements should be fully integrated with the software such that sample auto-centering and complete measurements should be possible through the software interface.

3.10. NIST standard samples must be provided for calibration of magnetic moment at low and high magnetic fields/temperatures.

3.11. In addition, the following DC magnetic property measurement options must be included in the quotation:

3.11.1. DC magnetization option must integrate First Order Reversal Curve (FORC) measurements and their analysis. Measurements should be possible on a variety of samples including bulk, thin films and nano materials.

3.11.2. FORC measurements must provide a quantitative fingerprint of the magnetic reversal mechanism, separating reversible and irreversible switching mechanisms, calculate reversal mechanism phase fractions and calculate coercivity and interaction field distributions. Supporting data sheet/brochure with measurements is essential to support the claims.

3.12. In addition, the following should be possible with the AC magnetic property measurement option:

3.12.1. AC drive amplitude range of 0.005 Oe to 15 Oe or greater should be possible. (*please provide data*)

3.12.2. AC drive frequency of 10 Hz to 10 kHz or above should be possible. (*please provide data*)

3.12.3. A phase resolution of less than or equal to 0.5 degrees should be possible.

3.12.4. The system and integrated software must allow for accurately separating the real and imaginary components of AC response.

3.12.5. Magnetization resolution should be less than or equal to 2×10^{-8} emu for AC measurements

3.12.6. It is critical that the system is capable of performing AC magnetization and DC magnetization measurements without any change in the hardware, sample motor or sample mount.
3.12.7. AC magnetic susceptibility option must be capable of performing real-time autocalibration at each measurement point while performing measurements rather than relying on a calibration table or data that was collected at a previous time. This is important for highly accurate measurements.
3.12.8. Thermometer for measuring temperature, should be mounted directly on the AC coil so as to reduce errors from thermal lags.
3.12.9. Options for measuring higher harmonics should also be quoted.
3.13. The magnetic property measurement system should be field-upgradeable to a high temperature VSM oven option

4. Electrical Property Measurement Option to be quoted

4.1. 4-wire and 2-wire resistivity options with simultaneous Hall Effect measurements and magneto-transport measurements should be possible with in-built electronics.
4.2. Such measurements should be possible over the temperature range of 1.8 K to 400 K in magnetic fields ranging from – 9 to +9 tesla.
4.3. A horizontal sample rotator with the following specifications should be provided:
4.3.1. An angular step resolution of ≤0.002 degrees per step should be provided.
4.3.2. The axis of rotation should be perpendicular to the sample bore.
4.3.3. The angular range should provide for a full 0- to 360-degree rotation.

5. Future upgrades

5.1. The system should provide field-upgradation possibility for the following options:
5.1.1. Thermal transport measurements including heat capacity and Seebeck coefficient measurements
5.1.2. The system should allow for the installation of an optical probe for high sensitivity photo-magnetic measurements
5.1.3. Field upgradability to Raman and other related optical spectroscopy techniques should be available.
5.1.4. Torque magnetometry and ferromagnetic resonance options as future upgrades should be possible.
5.1.5. The system should also allow for adding a He3 dilution refrigerator to attain temperatures of ~ 50 mK.
5.1.6. The prices of these upgrades should be quoted as options. Such pricing should be locked in for at least 18 months from the date of our purchase order.

6. Terms and Conditions

6.1. The vendor is responsible for the installation of the system at the institute.
6.2. The price quotation should include the cost of installation and training of potential users.
6.3. The system should be provided with at least two years of warranty, on all parts and labor, from the date of installation.

6.4. The vendor should have a track record of having previously supplied at least five advanced PPMS systems in India with identical options (as in sections 1-4). Details of such systems should be provided.
6.5. The vendor should have qualified technical service personnel for the equipment based in India and should assure a response time of <48 hours.
6.6. Vendor must provide a user list (with contact details including emails and phone numbers) of at least 5 customers from Indian Institutes/Labs where similar measurement systems are installed.
6.7. The lead-time for the delivery of the equipment should not be more than 6 months from the date of receipt of our purchase order.
6.8. The indenter reserves the right to withhold placement of final order. The right to reject all or any of the quotations and to split up the requirements or relax any or all of the above conditions without assigning any reason is reserved.
6.9. Wherever requested data must be supplied along with technical compliance documents. Technical bids without supporting data will be deemed as technically non-compliant.
6.10. All guaranteed specifications may have to be demonstrated at the time of installation. Any necessary standard samples for that purpose should be brought by the service engineers.
6.11. Printed literature and published papers in support of all compliance to the prescribed specifications may be provided.
6.12. The vendor must provide compliance statement in a tabular form with respect to each technical specification in the tender document duly supported by the manufacturer's literature and published papers. Any other claim will not be accepted and may lead to rejection of the bid.
6.13. Technical evaluation by the institute may include demonstration to verify functionalities and capabilities of the system quoted. The institute reserves the right to provide samples after opening the technical bids for the purpose of verification of promised specifications. Any discrepancy between the promised specifications and measurements will be deemed as technical non-compliance.
6.14. The vendor must quote for a non-comprehensive AMC price beyond the 2-year warranty, with a price lock in for 2 years beyond the standard 2-year warranty period. 2 services per year should be included in the AMC.
6.15. The quote should also include additional spares sufficient for two years of system usage assuming an average usage of 120 hours of operation per week. In addition, 8 sample pucks that are compatible with the system should be provided for physical property measurements.