

Quotations are invited for a low temperature and ultra-high vacuum (UHV) scanning tunneling microscope (STM) with the specifications listed below. The vendors must send their quotes in two bid system. The technical bids and the financial bids must be enclosed in two separate sealed envelopes. The envelopes must be properly labelled as “UHV-LT-STM Technical” and “UHV-LT-STM financial” respectively. The financial bids will be looked at only if the bids qualify technically.

1. The minimum temperature of the sample space with all necessary heat load should not be more than 380 mK with He3 gas.

2. **The system should be of “top-loading” type. This is a very important requirement and the vendors not meeting this point will not be considered.**

3. Maximum magnetic field should be equal to or more than 11 T.

4. Additional required specifications are described below:

The system should include at least three separate vacuum chambers.

(a) **The Load Lock Chamber:**

- The Load-lock chamber should be made of stainless steel grade SUS304 or SUS316 with minimum chamber diameter 110mm. The inside surface of the chamber should be electro-chemically polished. In case it is required at the drawing approval stage, minor modification to the dimensions should be done at no additional cost.
- The base pressure of the load lock chamber should be equal to or less than  $1.3 \times 10^{-5}$  Pa.
- The storage plate should be able to hold at least 4 sample holders and 4 probe or tip holders.
- A magnetic transfer rod should be installed for exchanging sample holder from the load-lock to the preparation chamber.
- Quick access doors should be provided for introducing sample and probe holders. Provision should be provided such that this door flange can be exchanged to normal conflate flange for higher vacuum operation.
- At least one leak valve of size ICF70 should be included for gas introduction into the chamber.

(b) **The Preparation Chamber:**

- The Preparation chamber should be made of stainless steel grade SUS304 or SUS316 with minimum chamber diameter 200mm. The inside surface of the chamber should be electro-chemically polished.
- The base pressure of the preparation chamber should be equal to or less than  $1.3 \times 10^{-8}$  Pa.
- The storage plate should be able to hold 4 sample holders and 4 probe holders. The storage stage should have a sample stage with wires connected to the sample holder for sample heating. The sample should be heated by direct current or EB (Electron Beam).

- There should be at least 4 viewing ports, one of size ICF114 and other three should be of size ICF70.
- Extra ports for accessories should be provided. The details of these ports are given below:
  - (1) The size of ports for RHEED and LEED should be ICF70 and ICF203.
  - (2) For deposition the size of the port should be ICF114.
  - (3) Three viewing ports, one of size ICF114 and the other two of size ICF70 should be given.
  - (4) Four extra ports of size ICF70 should also be provided.
- A magnetic transfer rod should be installed for exchanging sample and the probe between preparation and exchange chamber.

(c) **The Exchange Chamber:**

- The Exchange chamber should be made of stainless steel grade SUS304 or SUS316 with minimum diameter 110 mm. The inside surface of the chamber should be electro-chemically polished.
- The storage plate should be able to hold 4 sample holders and 4 probe holders.
- The sample storage should use a long magnetic transfer rod by which the samples and the probes can be exchanged to STM scanning head. A pulley balance unit should also be included.
- Five ports should be provided. Two viewing ports of size ICF70 and the other three ports of same size, i.e., ICF70 for deposition or gas inlet. The arrangements of ports should be discussed.

(d) **Cryostat:**

- The dewar of the cryostat should be equal to or larger than 60 liters capacity and it should not contain liquid nitrogen outer jacket. The consumption rate should be equal to or smaller than 0.5 liter/hour. He-3 refrigerator for SPM should be preferably designed and manufactured by Janis or an equally reputed company with specialization in He3 based UHV systems with high frequency co-axial wiring capabilities. The refrigerator should have the capacity of minimum 10 liters of He-3 gas. This size should be increased if required in order to satisfy the holding time requirement. The holding time at the lowest temperature should be equal to or longer than 24 hours with 1K pot pumping. The required amount of He3 gas should also be included.
- LHe cryostat should have minimum 60 liters capacity and the consumption rate should be equal to or less than 0.5 liter/hour. LHe level meter and over pressure relief valve should also be included.
- PID temperature controller with 4 channel input and dual heater output should be provided. Temperature sensors should also be included.
- Operation temperature should vary between 380mK to 2K by using 3He operation. Variable temperature operation should be made possible to vary from the minimum temperature to 50K using temperature controller. For maximum stability operation must be obtained at 380mK, 2K, and

4.2K without feed-back control. The temperature sensors should be appropriately calibrated so that measurements up to 300 K and beyond is also possible.

- Superconducting magnet of maximum magnetic field 11 T or larger perpendicular to the direction of the sample surface should be provided. Magnets must have persistent mode. Magnet controller should also be included for the magnet (input AC220-230V).

(e) **STM scanning Head and UHV 3He Insert Chamber:**

- 3He insert should be consisted of 1K pot, liquid 3He pot and sorption pump pot. The holding time at 380mK should be equal to or longer than 24 hours with pumping of 1K. The holding time at 430mK should be equal to or longer than 8 hours without pumping 1K pot.
- The insert chamber should be made by stainless steel SUS316 and other parts should be nonmagnetic.
- Coil springs should be installed on the STM head for internal vibration isolation.
- XY scan range should be greater than 2/0.6/0.6 micron at RT/4.2/K/0.4K respectively.
- Z servo range should be greater than 250/70/60 nm at T/4.2/K/0.4K respectively.
- Resolution Z should be less than 0.02 nm at 0.4K.
- Resolution XY should be less than 0.05nm at 0.4K.
- Desired noise level:  $<1 \text{ pm}/\sqrt{\text{Hz}}$ , Drift rate: 0.5nm/hour at 380 mK.
- In sample stage, coarse motion should be in  $\pm 0.5\text{mm}$  of XY direction. STM unit should be designed for 6 electrode type sample holder. 6 individual wires from sample stage should be provided for 6 electrodes sample holder.
- Sample and tip holder must be transferrable into STM at low temperature and must be top loading type.

(f) The controller should have similar or better specification as RHK R9 SPM Controller and it must have internal lock in function for dI/dV spectroscopy.

(g) **Vacuum System:**

- Pressure Gauge: Nude ion gauge head for 3 chambers is required. One multi-channel gauge controller, supplied from a reputed vendor ( like Varian, Pfeiffer, Edwards), should be provided for the ion gauges.
- Valves: Two manual gate valves (VAT) of size ICF114 should be provided between load lock chamber and preparation chamber; and between preparation chamber and exchange chamber. Another gate valve of size ICF70 should be provided between exchange chamber and 3He insert chamber. A pneumatic controlled angle valve should be included for load lock chamber. One ICF152 or ICF203 gate valve should be provided for ion pump on preparation chamber.
- Ion pump with TSP for the preparation chamber is needed.
- Ion pump with TSP for the exchange chamber is needed.

- Ion pump controller: All the necessary controllers with all required cables should be provided.
- 300 l/sec turbo molecular pump (preferably from Edwards or Pfeiffer or Agilent ) and 110 l/min scroll pump (preferably from Edwards) should be installed for load lock chamber. 1 scroll or rotary pump should be installed for 1K pot pumping.

(h) **Vibration Isolation table:**

- Table should contain air damping system of 4 leg type with automatic pressure control and it should be made of purely non-magnetic materials (preferably stainless steel SUS304/SUS316).
- Size: approx.. 1000L×900W×1200H mm.
- Weight should be less than 1000 Kg.

(i) **The following Standard accessories should be provided:**

- Three sets of direct current heating type, three sets of EB heating type and three additional sample holders for electrical gating should be provided.
- Five sets of probe holders should be provided.
- Twenty pieces of PtIr probes should be provided.
- One set of sample handing parts should be provided.
- Two sets of LED light source and ICF70 flange coupler should be included.
- One set of LHe transfer tube should be included.
- Heaters and thermo sensors should be installed on each chamber. Three ribbon heaters should be provided.
- One set of instruction manual should be given.

(j) **Installation:** The equipment with all its accessories and modules must be installed onsite. Onsite training should be provided to the students.

(k) **Acceptance Inspection:** Quantity and appearance checking as well as low temperature performance should be demonstrated below 380 mK with <sup>3</sup>He gas: Atomic resolution imaging of the 7×7 reconstruction of the Silicon(111) surface and spectroscopy on at least one conventional superconductor showing clear coherence peaks must be successfully performed during the installation.

**Additional Attachments: (must be quoted separately along with the equipment.**

1. 2kV, 10 micro Amp backfill ion source and a controller should be installed on the preparation chamber for sample and probe cleaning. In the case of mounting a plurality of evaporator, one power supply should be shared.
2. Electron Beam heater for STM tip should be provided for STM tip cleaning by EB bombardment. A HV controller (approximately 1.5kV-5mA) for the same purpose should also be included.
3. Linear motion manipulator with cooling and cleaving stage for exchange chamber, <20K with liquid Helium, <90K with liquid nitrogen should be included.
4. X Y Z and  $\Theta$  manipulator with cooling stage in preparation chamber, <40K with liquid Helium,

<100K with liquid Nitrogen should be provided.

5. UHV Multi-element Miniature Evaporator:

K-cell evaporator for metal deposition in UHV and controller. Evaporator should have a water cooling jacket and shutter mechanism and also W-Re thermo couple to monitor the cell temperature(PI controller). Its temperature range should be 300-1500<sup>0</sup>C.

6. UHV Multi-element Miniature Evaporator:

K-cell evaporator for molecular deposition in UHV and controller. Evaporator should have a water cooling jacket and shutter mechanism and also K thermo couple to monitor the cell temperature(PI controller). Its temperature range should be 150-800<sup>0</sup>C.

7. Electron beam power supply for heating the sample should be included.

8. Electrochemical Etching system should be added for STM tip.

9. Four semi rigid coaxial cable for high frequency(10dB/m at 1 GHz) should also be included.

In case the vendors can provide better specification than what have been listed here, that should be clearly and separately written at the end of the technical bid. In case the purchase committee feels it necessary, experienced engineers from the vendor's side must be able to come to IISER M and meet the committee in less than 2 weeks notice after the technical bids are open.