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|  | INDIAN INSTITUTE OF TECHNOLOGY MADRAS Chennai 600 036 Telephone: [044] 2257 9798/9723 FAX: [044] 2257 4855 E-mail: arpp@iitm.ac.in |  |
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V. Sathyanarayanan
Senior Manager (Project Purchase)

Ref: PHY/JKRA/008/2018
Date: 05.11.2018

Open Tender No: PHY/JKRA/008/2018

Due Date: 26th November 2018, 2pm

Pre-Bid meeting: - Not required.

Technical Bid opening meeting on 26th November 2018, 3:30 PM at Department of Physics, IIT-Madras.

Dear Sir/Madam,

On behalf of the Indian Institute of Technology Madras, offers are invited for the supply of **“Atomic Layer Deposition (ALD) System”** conforming to the specifications given in Annexure I.

Vendor who can supply and integrate the above equipment alone need to respond to the tender please.

Instructions to the Bidder

- I. **Preparation of Bids:** - The tenders should be submitted under two-bid system (i.e.) Technical bid and Financial bid.
- II. **Delivery of the tender:** - The tender shall be sent to the addresses mentioned below, either by post or by courier so as to reach our office before the due date and time specified in our schedule. The offer/bid can also be dropped in the tender box on or before the due date and time specified in the schedule.
The tender box is kept in the office of the:

**Senior Manager,
Project Purchase,
IC & SR Building 2nd floor,
I.I.T. Madras,
Chennai - 600 036.**
- III. **Opening of the tender:** - The offer/bids will be opened by a committee duly constituted for this purpose. The technical bids will be opened first and will be examined by a technical committee which will decide the suitability of the bids as per our specifications and requirements. All bidders will be invited for opening of the technical bids. With respect to opening the financial bid, only technically qualified bidders will be called.
- IV. **Prices:** - The price should be quoted in net per unit (after breakup) and must include all packing and delivery charges to the **Department of Physics**. The offer/bid should be exclusive of taxes and duties. The percentage of tax & duties should be clearly indicated separately. Kindly note that IIT Madras is eligible for concessional GST and relevant certificate will be issued.

In case of import supply, the price should be quoted without custom duty. IIT Madras is exempted from levy of IGST on Imports and eligible for concessional custom duty (not exceeding 5%) and the price should be quoted on EX-WORKS and CIP basis indicating the mode of shipment.

- V. Agency Commission:** - Agency commission, if any, will be paid to the Indian agents in rupees after receipt of the equipment and its satisfactory installation. Agency Commission will not be paid in foreign currency under any circumstances. The details should be explicitly shown in the tender document even in the case of 'Nil' commission. The tenderer should indicate the percentage of agency commission to be paid to the Indian agent. The foreign Principal should indicate the percentage of payment and it should be included in the basic price quoted originally (if any)..
- VI. Terms of Delivery:** - The item should be supplied to the **Department of Physics, IIT Madras** as per the Purchase Order. In case of import supply, the item should be delivered at the cost of the supplier to our Institution. The Installation/Commissioning should be completed as specified in our important conditions.
- VII. Technical Bid Opening:** The technical bid will be on 26th November 2018, 3:30 PM at the **Department of Physics, IIT-Madras**. The financial bids of those tenders who are technically qualified will be opened at a later date under intimation to them.
- VIII. IIT Madras** reserves the full right to accept / reject any tender at any stage without assigning any reason.

Yours sincerely,

V. Sathyanarayanan
Senior Manager (Project Purchase)
IC&SR Building, I.I.T. Madras,
Chennai - 600 036.

SCHEDULE

Important Conditions of the tender

1. The due date for the submission of the tender is **26.11.2018, 2 pm.**

The offers / bids should be submitted in two bids systems (i.e.) Technical bid and financial bid. The Technical bid should consist of all technical details / specifications only. The Financial bid should indicate item-wise price for each item and it should contain all Commercial Terms and Conditions including Taxes, transportation, packing & forwarding, installation, guarantee, payment terms, pricing terms etc. The Technical bid and financial bid should be put in separate covers and sealed. Both the sealed covers should be put in a bigger cover. The Open Tender for supply of **“Atomic Layer Deposition (ALD) System”** should be written on the left side of the Outer bigger cover and sealed.

2. **EMD: - The EMD in the form of account payee DD for 2% value of the item in favor of Registrar IIT Madras should be enclosed in the cover containing financial bid.** Any offer not accompanied with the EMD shall be rejected summarily as non-responsive.

The EMD of the unsuccessful bidders shall be returned within 30 days of the end of the bid validity period. The same shall be forfeited, if the tenderers withdraw their offer after the opening during the bid validity period. The Institute shall not be liable for payment of any interest on EMD. EMD is exempted for Micro and Small Enterprises (MSE) as defined in MSE Procurement Policy issued by Department of Micro, Small and Medium Enterprises (MSME).

When no local agent, the foreign vendor can submit demand draft equal to 2% or wire transfer the amount to our account as detailed in the attachment (Annexure II) and enclose the proof with the financial bid.

3. **Performance Security: -** The successful bidder should submit Performance Security for an amount of 5% of the value of the contract/supply. The Performance Security may be furnished in the form of an Account Payee DD, FD Receipt from the commercial bank, Bank Guarantee from any nationalized bank in India. **The performance security should be furnished within 21 days from the delivery of the purchase order.**

Performance Security in the form of Bank Guarantee:- In case the successful bidder wishes to submit Performance Security in the form of Bank Guarantee, the Bank Guarantee should be routed through the Beneficiary Bank to the end user bank. Otherwise, the Indian Agent of the foreign vendor has to submit a Bank Guarantee from a Nationalized Bank of India.

The Bank Guarantee should remain valid for a period of sixty days beyond the date of completion of all contractual obligations of the supplier including the warranty obligations.

4. **Indian agent:** If an Indian agent is involved, the following documents must be enclosed:

Foreign principal's proforma invoice indicating the commission payable to the Indian Agent and nature of after-sales service to be rendered by the Indian Agent.

- ✓ Copy of the agency agreement with the foreign principal and the precise relationship between them and their mutual interest in the business.

5. The offer/bids should be sent only for a machine that is available in the market and supplied to a number of customers. A list of customers in India and abroad with details must accompany the quotations. Quotations for a prototype machine will not be accepted.
6. Original catalogue (not any photocopy) of the quoted model duly signed by the principals must accompany the quotation in the Technical bid. No prices should ever be included in the Technical bid.

7. Compliance or Confirmation report with reference to the specifications and other terms & conditions should also be obtained from the principal.
8. **Validity:** Validity of Quotation not less than 90 days from the due date of tender.
9. **Delivery Schedule:** - The tenderer should indicate clearly the time required for delivery of the item (subjected to the executive committee-IITMadras approval). In case there is any deviation in the delivery schedule, liquidated damages clause will be enforced or penalty for the delayed supply period will be levied.
If there is delay, the penalty will be @1% per week of delay subject to a max of 10% of the value of purchase order and if the delay is more than accepted time frame by IITM, the PO would be cancelled and liquidated damages will be enforced.
10. **Risk Purchase Clause:-** In the event of failure of supply of the item/equipment within the stipulated delivery schedule, the purchaser has all the right to purchase the item/equipment from other sources on the total risk of the supplier under risk purchase clause.
11. **Payment:-**
 - (i) No Advance payment will be made for Indigenous purchase. However 90% Payment against Delivery and 10% after installation are agreed to wherever the installation is involved. In case of import supplies the payment will be made only through 100% Letter of Credit i.e. (90% payment will be released against shipping documents and 10% after successful installation wherever the installation is being done).
 - (ii) **Advance Payment:** No advance payment is generally admissible. In case of specific percentage of advance payment is required, the Foreign Vendor has to submit a Bank Guarantee equal to the amount of advance payment and it should be routed through the Beneficiary Bank to the end user Bank. Otherwise, the Indian Agent of the foreign vendor has to submit a Bank Guarantee through a Nationalized Bank of India.
12. **On-site Installation:** - The equipment or machinery has to be installed or commissioned by the successful bidder within 15 to 20 days from the date of receipt of the item at site of IIT Madras.
13. **Warranty/Guarantee:** - As per the tender specification.
14. **Late offer:** - The offers received after the due date and time will not be considered. The Institute shall not be responsible for the late receipt of Tender on account of Postal, Courier or any other delay.
15. **Acceptance and Rejection:** - I.I.T. Madras has the right to accept the whole or any part of the Tender or portion of the quantity offered or reject it in full without assigning any reason.
16. **Do not quote the optional items or additional items unless otherwise mentioned in the Tender documents / Specifications.**

17. **Disputes and Jurisdiction:**

Settlement of Disputes: Any dispute, controversy or claim arising out of or in connection with this PO including any question regarding its existence, validity, breach or termination, shall in the first instance be attempted to be resolved amicably by both the Parties. If attempts for such amicable resolution fails or no decision is reached within 30 days whichever is earlier, then such disputes shall be settled by arbitration in accordance with the Arbitration and Conciliation Act, 1996. Unless the Parties agree on a sole arbitrator, within 30 days from the receipt of a written request by one Party from the other Party to so agree, the arbitral panel shall comprise of three arbitrators. In that event, the supplier will nominate one arbitrator and the Project Coordinator of IITM shall nominate an arbitrator. The Dean IC&SR will nominate the Presiding Arbitrator of the arbitral tribunal. The arbitration proceeding shall be carried out in English language. The cost of arbitration

and fees of the arbitrator(s) shall be shared equally by the Parties. The seat of arbitration shall be at IC&SR IIT Madras, Chennai.

- a. **The Applicable Law:** This Purchase Order shall be construed, Interpreted and governed by the Laws of India, Court at Chennai shall have exclusive jurisdiction subject to the arbitration clause.
- b. Any legal disputes arising out of any breach of contract pertaining to this tender shall be settled in the court of competent jurisdiction located within the city of Chennai in Tamil Nadu.

20. All Amendments, time extension, clarifications etc., will be uploaded on the website only and will not be published in newspapers. Bidders should regularly visit the above website to keep themselves updated. No extension in the bid due date/ time shall be considered on account of delay in receipt of any document by mail.

Acknowledgement: - It is hereby acknowledged that the tenderer has gone through all the conditions mentioned above and agrees to abide by them.

**SIGNATURE OF TENDERER
ALONG WITH SEAL OF THE
COMPANY WITH DATE**

Tender for Atomic layer deposition (ALD) system

Proposed use of the machine

To deposit very thin (predominantly) metal oxide layers at temperature below 200C for wafer based Silicon heterojunction (SHJ) solar cell applications.

Sample Dimensions:

- | | |
|---------------------|---|
| 1) Material | : C-Si wafer substrate, glass substrates |
| 2) Maximum Size (Ø) | : 4" square sized wafer |
| 3) Thickness | : 1 nm to 200 nm ALD layers on above substrates |

Required specifications ALD

System

- Remote plasma and thermal ALD system in the same chamber.
- Thermal and plasma processes may run sequentially as part of a recipe sequence without hardware changes

Reaction Chamber

- Process chamber machined from single block of aluminum and heated to 150°C to avoid condensation of precursors.
- Smooth internal shape with no dead areas for rapid purging.
- Removable inner chamber for cleaning

Plasma source

- Remote plasma by inductive coupled plasma source
- source diameter ≤ 65 mm
- ICP type: helical
- Generator with directly coupled automatic matching with vacuum capacitors
- Power ≤ 300 W
- RF power source 13.56MHz and automatic tuning
- Matching unit capacitor positions selectable as process parameters
- Ability to run plasma down to 10 mTorr

Substrate table (holder / lower electrode)

- Table can handle wafers up to 200 mm with easy placement of samples (two 4 inch wafers can fit on it).
- 30°C – 400°C Substrate table temperature uniformity $< \pm 2.0^\circ\text{C}$ @ 400°C
- Substrate table temperature control $< \pm 1.0^\circ\text{C}$

Sources

Precursor Handling (for solid/liquid precursors)

- 3 sources compatible with liquid or solid precursors (plus water), heated up to 200° C
- Heated precursor lines up to 200C \pm 0.5°C using moulded heater jackets
- 2 fast (10 msec) Swagelock ALD valves for each precursor
- Rapid pulsed bubbling with argon flowing down a dip tube into liquid sources
- Glove panel to protect operators during precursor exchange
- Bracketed water Pot and does valve

Gasses

- Gas pod, separately mounted for max 8 MFC controlled gas lines (each with its own MFC) for plasma gases and thermal gas precursors (such as NH₃, N₂, H₂, Ar and O₂).
- Fitted with 5 gasses: NH₃, N₂, H₂, Ar and O₂.
- Ozone generator and destruction unit fully integrated into the software.

Vacuum Measurement

- 1 Torr capacitance manometer gauge with deposition protection baffle for long term stability
- Capacitance manometer must measure process pressure during the ALD process

Process Control

- Swagelok ALD valves temperature controlled up to 200°C
- ALD valves controlled to minimum 10ms +/-1ms resolution
- Argon bubbler mass flow controller coupled to rapid divert system for short bubbling and purging, including a divert into the foreline (chamber exhaust)

Pumping configuration

- rotary pump >= 600 m³/hr
- VAT high vacuum gate valve

Analytical chamber ports

- 2 * KF16 ports in the process chamber for in-situ spectroscopic ellipsometry at 70 degree angle to the normal

Control system and software

- Control components integrated in the frame with no additional control racks
- Automatic recipe driven control with full flexibility to control all valves (within allowed safety interlocks) with times down to 10ms with a resolution of 1ms.
- Thermal management system with all temperature zones controlled via a multi-zone temperature PLC with software interface conveniently located on a single menu.
- Fully password protected access levels for different users.
- User levels access should be selectable by manager
- The system must be controlled by a Ultra fast PLC with digital and analog I/O
- Ultra fast control for precise precursor dosage down to 10msec step time and a resolution of 1msec there after
- Including auto leak check, auto MFC check
- Plasma hold function between process steps
- Windows 7 or higher based computer is the “user” interface.

FAT (Factory Accapatance)

- There will be a FAT visit before shipping the system and during FAT visit supplier would require to demonstrate one of the listed process for Site acceptance .

Safety and Interlocks

- Hardware safety interlocks necessary for safe operation of the tool.

Maintenance

- Ease of maintenance and chamber cleaning procedures.

Experience

Have at least 90 Plasma ALD systems in the field.

Direct support in India from OEM , onsite support by OEM within 48 working Hours .

Vendor to provide undertaking confirming the direct OEM support in India along with contact details of OEM engineers placed locally

Other requirements

- Supplier must do process acceptance of selected materials regarding uniformities and selected material properties (e.g., resistivity, refractive index).
- The system must meet the current CE regulations
- The supplier must provide assurance that environmental impact is being measured and improved by providing ISO 14001:2004 Certification
- Footprint of the system \leq 120 cm wide and 120 cm long
- Maximum height when system open: 1.80 m
- It must be possible to mount the gas pod and PC separately.
- The system manufacturer must:
 - Spare parts must be available for min 10 years ex stock in Europe/Asia
 - Supplier must confirm, that he runs a free of charge service hotline since min 3 years.
 - Add the telephone number and email and persons on the hotline
 - Telephone response time max 30 min, 5 days/ 12 hours
 - Service visit response time max 2 working days from OEM Engineer .
- The supplier must run his own application lab with ALD systems installed there.
- Supply min 3 references of similar systems. The vendor must have prior experience in the development of silicon heterojunction cells and must supply any published research work for reference.

Material the System Should be capable of depositing

- Aluminum fluoride (AlF₃)**, Uniformity 4%
- Tungsten oxide (WO₃)** , Uniformity 4%
- In₂O₃:H** @Uniformity 4%, electron mobility $> 130 \text{ cm}^2/\text{V}$ and resistivities $< 0.30 \text{ m}\Omega\text{cm}$
- Silicon dioxide** , Uniformity 4%
- Aluminum oxide doping in ZnO**
- Nickel oxide**, Uniformity 4%

1. Plasma ALD processes should be possible at temperatures below 100C.
2. Vendor should also suggest the precursors and gases required.

Should be Available as option:

- N₂ glove box
- 4th source compatible with liquid or solid precursors, heated up to 200° C

Warranty : 2 YEAR WARRANTY (cost/year of warranty for subsequent years to be provided)

Training : Training at IITM site for the user during commissioning.

Acceptance test

- Supplier must supply guaranteed processes for:
 - System must have in-situ plasma cleaning capability and recipe for the same must be provided at the time of commissioning.
 - System Must be capable to deliver below processes and vendor must demonstrate any three process selected by IIT from below materials at the time of acceptance

| Aluminium oxide | Thermal Al ₂ O ₃ | Plasma Al ₂ O ₃ |
|--|--|--|
| ALD temperature window (°C) | 120 – 400 | 25 – 400 |
| Growth per cycle (Å/cycle) | 0.95 at 200 °C 1.0 at 300 °C | ~1.2 at 200 °C |
| Thickness uniformity¹ (200 mm) | <± 3.0 % | <± 3.0 % |
| Refractive index at 632.8 nm (ex-situ) | 1.60 – 1.64 Ex 1.60 at 120 °C 1.62 at 200 °C 1.64 at 300 °C | 1.59 – 1.64 Ex. 1.59 at 25 °C 1.62 at 120 °C 1.64 at 200 °C 1.64 at 300 °C |
| Breakdown voltage (MV/cm) | >8 at 200 °C | >8 at 200 °C |
| Dielectric constant | >8.5 at 200 °C | >8.5 at 200 °C |

| Titanium dioxide | Plasma TiO ₂ | Thermal TiO ₂ |
|--|---|--------------------------|
| ALD temperature window (°C) | 50 – 350 | 200 – 300 |
| Growth per cycle (Å/cycle) | 0.40 – 0.55 at 200 °C | 0.6 at 250 °C |
| Thickness uniformity¹ (150 mm) | <± 3.0 % | <± 3.5 % |
| Refractive index at 632.8 nm (ex-situ) | 2.30 – 2.40 at 200 °C 2.35 at 300 °C 2.40 at 350 °C | 2.3 at 250 °C |

| Zinc oxide | Thermal ZnO | Plasma ZnO |
|--|------------------------|---|
| ALD temperature window (°C) | 50 – 200 | 50 – 200 |
| Growth per cycle (Å/cycle) | 1.9 at 150 °C | 1.3 – 1.7 at 150 °C |
| Thickness uniformity¹ (200 mm) | <± 3.5 % | <± 3.5 % |
| Refractive index at 632.8 nm (ex-situ) | >1.80 – 1.95 at 150 °C | >1.80 – 1.90 at 150 °C 2.3 at 250 °C |

| Molybdenum oxide | Plasma MoO₃ |
|---|-------------------------------|
| ALD temperature window (°C) | 100 – 350 |
| Growth per cycle (Å/cycle) | 0.75 at 120 °C |
| Thickness uniformity¹ (100 mm) | <± 5.0 % |
| Refractive index² at 632.8 nm (ex-situ) | >1.90 at 120 °C |



CENTRE FOR INDUSTRIAL CONSULTANCY & SPONSORED RESEARCH (IC&SR)
INDIAN INSTITUTE OF TECHNOLOGY MADRAS
CHENNAI 600 036



B NAGARAJAN
JOINT REGISTRAR (IC & SR)

Project Accounts
July 22, 2016

TO WHOMSOEVER IT MAY CONCERN

In connection with project, **US currency may be transferred to CANARA BANK, IIT - MADRAS Branch** with the following details.

FOR TRANSFER OF CURRENCY US DOLLAR

Please Credit in USD

(THROUGH)

JP MORGAN CHASE, NEW YORK
SWIFT CODE: CHASUS33

For Credit to

USD ACCOUNT No: 001-1395969, of CANARA BANK INTERNATIONAL DIVISION
MUMBAI

For Further Credit to

ACCOUNT NO: **2722101001741** of IIT Chennai – Swift Code: **CNRBINBBIIT**
OF THE REGISTRAR, IIT, MADRAS


JOINT REGISTRAR (IC & SR) i/c

संयुक्त कुलसचिव (आई.सी. एवं एस.आर.)
JOINT REGISTRAR (IC & SR)

आई.आई.टी. मद्रास

This is to certify that the particulars furnished are correct.

For Canara Bank

Senior Manager
Canara Bank - IIT Madras branch



एस. अरवींदन
S.ARAVINDAN
सीनियर प्रबंधक Senior Manager
प.अ.सं. S.P.No.31649