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Department of Physics

Corrigendum-3

Tender Reference no: **PHY/JKRA/008/2018**

Name of the Item: **Atomic Layer Deposition (ALD) System**

Corrigendum details: **Technical Specification revised**

As informed earlier the technical specification for above mentioned tender has been updated. The venders are requested to submit their bids considering the updated specifications into account.

All other terms and conditions remain the same.

Tender Inviting Authority:

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Tender for Atomic layer deposition (ALD) system

Required specifications

System

- Remote plasma and thermal ALD system in the same chamber.
- Thermal and plasma processes should be able to run sequentially as part of a recipe sequence without hardware changes
- Plasma ALD processes should be possible at temperatures below 100 °C

Reaction Chamber

- Process chamber should be machined from a single block of aluminum and heated to at least 150°C to avoid condensation of precursors.
- Smooth internal shape with no dead areas for rapid purging.
- Removable inner chamber for cleaning
- Vacuum Loadlock with dedicated pump suitable to load 200 mm wafers

Plasma source

- Inductive coupled plasma (ICP)
- Generator with directly coupled automatic matching with vacuum capacitors
- Power up to 300 W
- RF power source operating at 13.56MHz with automatic tuning facility
- Ability to run plasma down to 10 mTorr

Substrate table (holder / lower electrode)

- Table should handle wafers up to 200 mm with easy placement of samples (two 4 inch wafers should fit on it).
- Substrate table temperature should be able to be varied in the range 30°C – 400°C ; uniformity < ±2.0°C @ 400°C
- Substrate table temperature control: < ±1.0°C

Sources

Precursor Handling (for solid/liquid precursors)

- 3 sources compatible with liquid or solid precursors; should be able to be heated up to 200° C.
- Water precursor one source
- Precursor lines heated up to 200±0.5°C using moulded heater jackets
- Fast Swagelock ALD valves of two numbers for each precursor, that allow a valve open time of 10 ms.
- Precursor delivery: Pulsed bubbling with argon, facility for the tube to be into/ over liquid sources.
- Glove panel to protect operators during precursor exchange
- Water Pot and dose valve

Gasses

- Gas pod, separately mounted for at least 8 controlled gas lines (each with its own MFC) for plasma gases and thermal gas precursors
- MFC and electronics fitted for 5 gasses (SF_6 , N_2, H_2, Ar and O_2)
- **Option** for adding Ozone generator and destruction unit fully integrated into the software.

Vacuum Measurement

- Suitable size capacitance manometer gauge with deposition protection baffle for long term stability,
- Capacitance manometer must be able to measure process pressure during the ALD process

Process Control

- Swagelok ALD valves should be operable up to 200°C
- ALD valves controlled to minimum 10ms ±1ms resolution
- Argon mass flow controllers (MFCs) for bubbling and purging. Each MFC can be rapidly diverted to the foreline (chamber exhaust) using fast ALD valves.

Pumping configuration

- Oil free pump with pumping speed > 450 m^3/hr
- VAT high vacuum gate valve

Analytical chamber ports

- 2 * KF16 ports in the process chamber for attaching in-situ spectroscopic ellipsometry unit, an angle of 68-72 degree to the normal
- Must contain viewport for in-situ Optical emission spectroscopy

Control system and software

- Automatic recipe driven control with full flexibility to control all valves (within allowed safety interlocks) with response 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
- Auto leak check with alert, auto MFC check with alert
- Ability to retain match positions of matching unit capacitors between process steps
- Windows 7 or higher based computer for the "user" interface.

Safety and Interlocks

- Hardware safety interlocks necessary for safe operation of the tool should be provided

Maintenance

- Ease of maintenance and chamber cleaning procedures.

Experience

- OEM should have supplied at least 50 Plasma ALD systems around the world.
- Provide the address, contact details of three references where their ALD equipment was used for silicon heterojunction cell with supporting evidence.
- Direct onsite support in India from OEM .(provide undertaking confirming the direct OEM support in India along with contact details of OEM engineers placed locally)

Other requirements

- The system must meet the current CE or SEMI S2 regulations
- The supplier must provide assurance that environmental impact is measured and improved by providing ISO 14001:2004 Certification
- Spare parts must be available for min 5 years ex stock in Europe/Asia
- Supplier must confirm, a free of charge service hotline for min 3 years.

- The supplier should have own application lab with ALD systems installed to demonstrate process performance if required.
- Vendor supplies the details of the precursors to be used for depositing samples for the acceptance test (Optional)

Standard recipes for depositing the following layers must to be given)

i. **Aluminum fluoride(AiF3),**
ii. **Tungsten oxide (WO3)**
iii. **In_2O_3:H**
iv. **Silicon dioxide**
v. **Aluminum oxide doping in ZnO**
vi. **Nickel oxide**

Should be Available as option:

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

Warranty : 1 YEAR WARRANTY (cost/year of warranty for subsequent years to be provided)

Training : Training at IITM during commissioning.

Acceptance test

- Supplier must supply guaranteed processes for:
  1. System must have in-situ plasma cleaning capability and recipe for the same must be provided at the time of commissioning.
  2. System **must** be capable to deliver below processes and vendor must demonstrate below three process

Aluminium oxide	Thermal Al_2O_3	Plasma Al_2O_3
ALD temperature window (°C)	120 – 400	25 – 400
Growth per cycle (Å/cycle)	Min 1.0 at 200 °C	Min 1.2 at 200 °C
Thickness uniformity (200 mm)	<± 3.0 %	<± 3.0 %
Refractive index at	1.60 – 1.64	1.60 – 1.64

632.8 nm (ex-situ)		
Breakdown voltage (MV/cm)	>8 at 200 °C	>8 at 200 °C
Dielectric constant	>8.5 at 200 °C	>8.5 at 200 °C

Zinc oxide	Thermal ZnO	Plasma ZnO
ALD temperature window (°C)	50 – 200	50 – 200
Growth per cycle (Å/cycle)	Min 1.5 at 150 °C	Min 1.5 at 150 °C
Thickness uniformity (200 mm)	<± 3.5 %	<± 3.5 %
Refractive index at 632.8 nm (ex-situ)	1.80 – 1.90 at 150 °C	1.80 – 1.90 at 150 °C

Molybdenum oxide	Plasma MoO_3
ALD temperature window (°C)	100 – 350
Growth per cycle (Å/cycle)	Min 0.75 at 120 °C
Thickness uniformity (100 mm)	<± 5.0 %
Refractive index at 632.8 nm (ex-situ)	1.9-2.1 at 120 °C

FAT (Factory Acceptance Test)

- There will be a FAT report before shipping the system to demonstrate one of the processes listed above for acceptance. Remote demonstration by camera or skype must be done.
- Visit for two personnel from IITM during FAT (optional)