

## Detailed Specifications of Open Tender Notice No: 18/2012

<b>S. NO.</b>	<b>TENDER NO.</b>	<b>BRIEF DETAILS OF ITEM(S)</b>	<b>PAGE NOS.</b>
1.	14-IV/SK(33)12-PB/T-234	Gas Chromatograph	2
2.	14-VI/BKG(677)12-PB/T-235	Thin Film Deposition System (Electron Beam Evaporation System)	3-4
3.	14-VII/V(2344)12-PB/T-236	Dispensing System for liquid/pastes	5
4.	14-III/RP(450)12-PB/T-237	Small Angle X- Ray Scattering (SAXS) System	6-7
5.	14-III/RP(451)12-PB/T-238	Ultra High Sensitive– Optic Kerr Effect (MOKE) Magnetometer system	8-9

6/2

## SPECIFICATION OF GAS CHROMATOGRAPH

Gas Chromatograph (GC) will be used for the analysis of gaseous ambient nonpolar and polar Volatile Organic Compounds (C<sub>2</sub>-C<sub>12</sub>) simultaneously. GC should consist of Electronic Pneumatics Control (EPC), dual channels, suitable Columns, two FID Detectors which can be used simultaneously, Sample Pre-concentrator, sample Injection System and Multi Canister automatic system for sample transmission and injection. The GC should be automated, programmable and software controlled.

### Details of Technical Specification

Items	Details	Technical details
Parameters	Gaseous Ambient Volatile Organic Compounds (VOC) collected in Canisters	from C <sub>2</sub> to C <sub>12</sub> to be analyzed simultaneously
Performances	Retention Time repeatability	≤0.15% RSD
	Area Repeatability	≤5% of RSD
Injectors	Type	Split/Splitless, 2 Nos
	Temperature range (maximum)	≥400° C
	Total flow setting range	0 to 100 ml/min or higher
Inlets	Pressure setting range	0 to 60 psi or higher
	• Maximum temperature	≥400°C
	• Carrier flow range	0 to 100 ml/min or higher
Column	Suitable column for detection of nonpolar and polar Volatile Organic Compounds (C <sub>2</sub> -C <sub>12</sub> )	
Column Oven	Temperature Range	
	1. Ambient	15 ° C to 450 ° C
	2. Liquid N <sub>2</sub> (sub ambient)	-80 ° C to 450 ° C
	Temperature Set point Resolution	≤1 °C
Detectors	Type	Flame Ionization detector (2 Nos)
	Detection limit	≤3 pgC/sec
	Temperature range (maximum)	≥400° C
	Dynamic range	≥10 <sup>6</sup>
Sample Pre-concentrator and Injection System	<ul style="list-style-type: none"> <li>• Thermal Desorption System or equivalent</li> <li>• Automatic System for transmission of Air Samples from multi number of Canisters and injection to GC for detection and quantification of Volatile Organic Compounds (C<sub>2</sub>-C<sub>12</sub>)</li> <li>• Suitable Cold Trap or Cryofocusing trapping System with Cryogenically or Thermo Electrically cooled for pre-concentration of sample to detect and quantify Volatile Organic Compounds (C<sub>2</sub>-C<sub>12</sub>)</li> <li>• Suitable arrangement for the removal of H<sub>2</sub>O and CO<sub>2</sub> from the air samples without disturbing polar molecules</li> <li>• The system should be synchronized with GC for operation</li> </ul>	
Calibration Gases	Hydrocarbon gas Mixture of calibration gases for GC-FID Volatile Organic Compounds(C <sub>2</sub> -C <sub>12</sub> ) traceable to National Metrology Institute (NMI) in cylinder of 10 liter Water Capacity	
Power	Voltage 230±10% VAC, 50Hz	
Spares and accessories	All the necessary spare parts, accessories and consumables required for installation and commissioning and warranty period must be provided by the bidder. <i>List of such items should be provided with offer</i>	
Software/ Data handling/ Manual	<ul style="list-style-type: none"> <li>• Latest branded PC hardware with 21" TFT monitor and Printer with preloaded as well as license version Operating System (OS) software for GC data processing</li> <li>• Operating and Service MANUALS</li> <li>• Required software for instrument control, data acquisition, data processing and data analysis, report generation, files processing, hardware Functions, network compatibility, maintenance guide, additional diagnostic tests built in for hardware fault detection.</li> <li>• Software should be capable of running two channels simultaneously and synchronization of the Sample Pre-concentrator and Injection system with GC</li> </ul>	
Warranty	Warranty for a period of 12 months from the date of successful installation and commissioning of the instrument	
Training	On site training on operation of GC to at least two persons should be provided	

### Optional

<ul style="list-style-type: none"> <li>• Performance evaluation for Instrument qualification (IQ), Performance qualification (IQ), Operation Qualification (IQ) during installation and commissioning.</li> <li>• Annual Maintenance Contract (AMC) for three years after the warranty period .</li> <li>• Branded 5 KVA UPS for power backup of 30 minutes for GC</li> <li>• For detection of Volatile organic Compounds (C<sub>2</sub>-C<sub>12</sub>) price should be provided for following columns:                             <ul style="list-style-type: none"> <li>-HayeSep-A (12 feet, 1/8" OD, 80/100 mesh) - One No</li> <li>-HayeSep-D (12 feet, 1/8" OD, 100/120 mesh) One No</li> <li>-Molecular Sieve 13X (10 feet, 1/8" OD, 80/100 mesh)- One No</li> <li>-Capillary-GS Alumina (0.53mm, 30 m)- One No</li> <li>-DB1- (0.32mm, 60 m)- One No</li> <li>-Capillary-PLOT Alumina/KCl- (0.32mm, 50 m) -One No</li> </ul> </li> <li>• Necessary spare parts, accessories and consumables for three years trouble free operations after warranty period</li> </ul>
---

\*\*\*\*\*

## Specification of Thin Film Deposition System

### (Electron Beam Evaporation System)

#### 1. Scope of the System :

A thin film deposition system with provision for **Electron beam and thermal evaporation** should include all necessary controls, pumps, valve, power supplies, instrumentation etc.

#### 1.1 **Vacuum Chamber:**

*1.1.1* Shape of Chamber: Cylindrical shaped (SS304 or better grade) front-loading chamber with two viewing ports, 400-450 mm diameter with height: 500-550 mm.

*1.1.2* The complete chamber should be stainless steel (SS304 or better grade) finely machined & electrochemically polished and with all necessary feed through ports. Front side open window for placing samples.

*1.1.3* Provision for two additional feed throughs with blinds.

#### 1.2 **Chamber Gadetry:**

*1.2.1* Substrate holder accommodates 3 substrates of 50mm diameter with rotation up to 15rpm.

*1.2.2* Manually operated substrate heater for variable temperature from room temperature to 350 degree centigrade with digital temperature indicator and controller.

*1.2.3* Temperature uniformity across the substrate within  $\pm 2\%$  and temperature accuracy within  $\pm 2\%$ .

*1.2.4* Minimum distance between source and substrate holder should be 5 inches and manual adjustment to increase the distance up to 8 inch.

*1.2.5* Provision for arc cleaning of the substrate.

*1.2.6* Source shutter: Electromagnetic source shutter with rotary shaft seal, shutter arm, removable shutter pan, and solenoid actuator made with stainless steel for minimum out gassing and shutter open with/shut control with remote facility.

#### 1.3 **Electron Beam Gun and Powder Supply:**

*1.3.1* 15kV, 3kW capability standard EB gun (imported and branded companies like Kurt J. Lesker, Plasmaterials, Testbourne, Veeco/Sloan, Oaresearch and Omicron ) with power supply with beam scanning to evaporate the materials like yttrium oxide, terbium oxide or other rare-earth oxides with film thickness accuracy of  $\pm 5\%$  at 100nm.

*1.3.2* Provision for three crucibles with motorizes positioning system.

#### 1.4 **Thermal Evaporation:**

*1.4.1* Suitable assembly for thermal evaporation using filament / basket/boat arrangement.

*1.4.2* Suitable L.T. and H.T. sources for thermal and e-beam evaporation respectively.

#### 1.5 **Thickness Monitor:**

*1.5.1* Suitable thickness monitor for in-situ monitoring.

#### 1.6 **Vacuum Pumping System:**

*1.6.1* Suitable Turbo based pumping system (with rotary backing) to achieve ultimate high vacuum  $1 \times 10^{-7}$  torr within 60 minutes.

**1.6.2** Pumps should be of standard make (Edward/ Varian/ Alcatel/ Oerlikon/ Pfeifer/ Leybold/ Osaka).

**1.7 Vacuum Measuring Gauges:**

**1.7.1** One pirani gauge for line vacuum and combination gauge for chamber vacuum from atmosphere to  $1 \times 10^{-7}$  torr at least.

**1.8 System Electrical Supply:**

**1.8.1** As per Indian standard, Phase reversal protection, RMI and EMI filters.

**1.9 System Protection:**

**1.9.1** All safety interlocks as per international norms.

**2.0 Consumable Spares:**

**2.0.1** Consumable for at least one year (boats, baskets, filaments, crucibles, o-rings and gaskets).

**2.1 Demonstration:**

**2.1.1** Process is to be demonstrated for evaporation of rare-earth oxides with film thickness within  $\pm 5\%$  at 100 nm during pre-dispatch inspection (at NPL cost).

**2.2. Optional:** Basic set of critical spares with reasonable quantities (boats, baskets, filaments, crucibles, o-rings and gaskets).

\*\*\*\*\*

**Automatic Dispensing System for liquid/pastes**

**Specifications:**

1. Dispensing Area: Capable of handling devices of circular, square and pseudo-square shapes of area ranging from  $4 \text{ cm}^2$  to  $400 \text{ cm}^2$ .
2. Speed: variable (50-500 mm/s)
3. Reproducibility: 0.025 mm
4. Liquid/Paste viscosity: 5-40 Pa.s(at room temperature)
5. Compatible with etching paste isishape Solar Etch® SiD paste (Merck Chemicals, Germany that requires dispensing pressure 4 bar @ 80mm/s and typical needle diameter ~200 micron and pH ~11).
6. Necessary software and interfaces.
7. Process should be demonstrated at NPL and training should be provided.

**Optional:**

8. Heating stage:  $250 \text{ }^\circ\text{C} \pm 5^\circ\text{C}$ .
9. Accessory and essential spares for five year
10. Complete PC with printer

\*\*\*\*\*

**Small Angle X-ray Scattering (SAXS) equipment with the following Specifications:**

S.No.	Features	Specification
1	X-ray Source	X-ray Micro-source with Pin-hole or a Sealed tube with both Line and Point (Pinhole) focus arrangement with simple method for change by user, Cu anode at max. 40KV and 50mA.
2	Beam Configuration:	Single beam line with Line or Point Collimation changeable by the User. System should be Upgradable to dual beam in future using the same source
3	X ray Flux	Maximum monochromatic X-ray flux at Sample: $1.0 \times 10^7$ photons/s or better. Purity of the monochromatic beam should be Cu K alpha is $\sim 99\%$ and K beta $< 0.02\%$ .
4	System Resolution	$q_{\min}$ : $0.05 \text{ nm}^{-1}$ or better $q_{\max}$ : $28 \text{ nm}^{-1}$ or better the q range should be continuously variable between minimum and the maximum value. Simultaneous mode for small and wide angle data collection on the same detection plane is preferred. However if the same range is met by combination of more than one detector, then the same will be given due consideration.
5	X ray optics	Multilayer mirror providing a highly intense and monochromatic X-ray beam using 1D focusing multilayer optics
6	Spot size	At the sample: $2000\mu\text{m} \times 300\mu\text{m}$ in Line mode or better and $300\mu\text{m} \times 300\mu\text{m}$ or lower in POINT mode
7	Detector type	Any Two Dimensional Detector with a pixel resolution of about $60\mu\text{m} \times 60\mu\text{m}$ size or lower. Size of the Detection plane should be such that it should cover Small and Wide angles from $0.05^\circ$ up to $35^\circ$ or higher. If more than one Detector is required to cover the above range then the same may also be quoted
8	Beam Stop	A Beam stop with variable position and known transmission is preferred to get automated sample absorption correction done and the zero-angle position is measured in all sample runs. However a Standard Beam stop with any other technical advantage will be given due consideration
9	Beam path	Short beam path with 1-3 mbar vacuum achievable in less than 10 min using an Oil-free vacuum pump The pump should have auto off/on function and should maintain constant vacuum with no noise and vibration.
10	Sample stage type	Standard range: External vertical and tilt alignment with Peltier Heating/Cooling unit with a minimum temperature range from $0^\circ\text{C}$ to $100^\circ\text{C}$ .
11	Sample holders	Sample Cells: To Investigate any kind of samples as below: <ul style="list-style-type: none"> <li>• Quartz capillaries for Liquids, Dispersions, Emulsions, Suspensions, Polymer Solutions, Surfactants, etc.</li> <li>• Sample holder for solids like paste, powder &amp; films.</li> </ul>
12	Safety features	The system should be designed to meet safety radiation of $1 \mu\text{SV/hr}$ or less under regular operation. System should also equip with safety sensors, which activates automatically under unsafe system operation and close X-ray shutters.

13	Integrated PC control	Automated data acquisition and control through latest PC. The system should be able to perform time resolved experiments in a few seconds
14	Data Analysis software	Basic Features: System Software should be Powerful image processing and data evaluation software, which effectively speeds up the processing of SAXS raw data. Fast and simple data reduction to handle data from line and point collimation experiments. It should convert 2D SAXS images into 1D profiles with -Automatic data process templates -Automatic templates are designed to perform data process steps -automatically such as data background subtraction, normalization and -De-smearing correction.
15	Advanced SAXS Software:	Should offer advanced software for SAXS data interpretation to do following minimum functions -The software should use mathematical methods (Fourier inversion, de-convolution) to retrieve the structure information from the experimental SAXS data. Most importantly, method used should be model free and should allow determination of particle shape and structure, core shell structure as well as size distribution. -The software should allow to interpret scattering data of interacting (i.e., concentrated or charged) particle systems from a single experiment eliminating the need to run a series of measurements with different concentrations. The Software should separate Structure factors and Form Factors from a Single Run of Concentrated System -Simulation and model calculations -In order to relate structure models to the obtained results, the software should calculate theoretical models. It should allow to design individual structure models or to import crystallographic structure files (e.g. inorganic / organic Data Bank files or other file formats).
16	Chiller unit	Imported compact closed circuit chiller unit to cool the SAXS X- ray tube.
17	Power Supply	Operating power supply : 220V (+/- 10%), 50Hz as per Indian standard..Vender should provide necessary requirement for power supply connection.
18	Warranty & training	Atleast 12 month warranty and the training for learning the software simulations, operation and maintenance of SAXS should be provided.
19	Optional	<ol style="list-style-type: none"> <li>1. Additional Image plate /CCD detector should be quoted.</li> <li>2. Additional X-ray tube.</li> <li>3. Quartz sample Capillary.</li> <li>4. AMC charges for 5 years should be quoted.</li> <li>5. Vendor must quote for critical spares necessary for three years</li> </ol>

\*\*\*\*\*

**Ultra-high Sensitive Magneto-Optic Kerr Effect (MOKE)-Magnetometer system with following specifications:**

1. Laser Source:

- Any wave length (nm) in the range: 630-670.
- Power output (mW): 5 or higher.
- Output type: Continuous wave.
- Polarization: Plane Polarized.
- Laser type: Both Intensity as well as Frequency stabilized modes (user selectable).
- Spot Size: capability of focusing on sample to  $\leq 2 \mu\text{m}$  spot diameter.

2. MOKE Configuration: **All** three measurements modes namely, Longitudinal, Transverse and Polar MOKEs are required.

3. Magnetic Field:

(I) Electromagnet: Quadrupole type

- $\pm 1000$  Gauss or higher for Longitudinal, transverse and Polar and MOKE configurations.
- Field uniformity of 1 part in 100 or better over 3 mm or higher is required.

(II) Electromagnet: Dipolar type

- $\pm 4000$  Gauss or higher for both Longitudinal, transverse MOKE configurations.
- $\pm 2000$  Gauss or higher for polar MOKE configuration.
- Field uniformity of 1 part in 100 or better over 3 mm or higher is required.

(III) Suitable sensitive field measurements device:

- Two Hall Probes.
- Absolute field resolution – 100 mG or lower for the entire field range for Quadrupole and Dipolar electromagnets.
- 16 bit digital resolution or better.

4. Anti-vibration optical table:

- Dimensions: Appropriate to house the MOKE set-up.
- Passive air damping system which damps vibrations with resonance frequency of 4.Hz or better and compatible pump for adjustment of pressure.

5. Kerr-Rotation Signal Resolution & Ellipticity measurements:

- $5 \times 10^{-4}$  degree or lower (Kerr rotation).
- Simultaneous measurements of both Kerr Rotation & Ellipticity as function of magnetic field.
- Loop recording frequency variable from 0.1 – 50 Hz or wider.
- Data points per loop: User selectable in the range of 2500 or higher.

6. Provision for accurately locating and positioning the sample/laser spot with magnification from  $\times 10$  to  $\times 100$ .

7. Cryostat for variable Temperature requirement:

- Range: 4.2 K – 450 K or wider with temperature stability of  $\pm 0.1$  K or lower.
- Temperature control: Liquid Helium flow based via automated needle valve through temperature controller with appropriate pump for Helium pumping.
- With suitable temperature sensor compatible with measurements in magnetic field environment.
- Helium transfer line.
- Cryostat should be mechanically mounted or supported on a suitable stand.

8. Fully automatic control along with manual override of sample stage for the operation of MOKE. Control Software should be compatible with windows 7 or higher operating system on PC.

9. Data collection & analysis – Online/Offline data analysis (to filter the noise in hysteresis loops and automatic measure of coercive and remanence field, removal of artefacts in the loops, complex measurements process, advance image process, brightness-contrast & profile measurement) software compatible to windows 7 or higher platform should be provided.

10. Three bench mark test samples should be provided.

11. Installation & operational training for 2 staff members of NPL at customer site along with testing of the system using test batch samples.

12. Comprehensive warranty for 2 years after successful installation & commissioning.

**Optional accessories (to be quoted separately)**

- AMC for 5 years after mandatory 2 years of warranty.
- Additional liquid Helium transfer line.
- Compatible sample holder for loading liquid samples.

\*\*\*\*\*