



**INDIAN INSTITUTE OF TECHNOLOGY BOMBAY**  
**MATERIALS MANAGEMENT DIVISION**  
**Powai, Mumbai 400076**

**Volumetric Gas Analyzer System – Detailed specification**

**Essential requirements:**

- The system must be capable of performing gas absorption and desorption measurements using the manometric method. This system should be capable to give static PCT isotherms, kinetics study and cyclibility of hydride based materials.
- The instrument control software must allow fully programmable, automated operation.
- The system must include a minimum of two gas inlets (for helium, plus one working gas) with automated programmable switching between inlets.
- The system must be compatible with operating gases including H<sub>2</sub>, CH<sub>4</sub>, CO<sub>2</sub>, and N<sub>2</sub>. Any operating restrictions must be stated.
- The system must be equipped with a sample reactor that can be thermostatted at any temperature up to +500 °C with stability +/-1 °C or better under pressures between vacuum and 200 bars.
- The sample reactor must be able to accommodate samples of up to 1 cc volume, and have total dead volume 8 cc or smaller. The dosing volume should be optimised to match the reactor volumes for high accuracy manometric absorption-desorption measurements and should not exceed 8 cc.
- The system must be suitable for high precision gas absorption measurements with pressures up to at least 200 bar. It must be supplied with a fully interfaced turbomolecular pump and vacuum gauge for sample degassing, and computer controlled pneumatically operated all-metal diaphragm valves. The pumping station including backing/roughing pump must be completely free from oil and included.
- The system must be equipped with a 0-200 bar pressure transducer with accuracy +/-0.04% Full Scale or better.
- The instrument must be capable of measuring full absorption and desorption isotherms with a resolution of 5 micromole or better using hardware compatible with the full operating pressure range.
- System must be delivered with personal computer and necessary software to operate the instrument included in the offer. The software must be fully compatible with Windows 10 64bit operating systems.
- Installation and on-site user training must be included.
- Reference material should be provided to ensure the accuracy of the instrument.
- The equipment should include sufficient number of O-rings for multiple future usage.

- The system should be supplied with gas booster to assure the constant supply of high gas pressure. The gas booster facility must be integrated with software that controls the equipment. The gas booster may be quoted optional.

### **Upgradability**

The instrument must allow a full range of upgrades which can be fitted in the customer laboratory:

- A third programmable gas inlet must be available as a future upgrade, to increase the range of automated measurements possible.
- Additional expansion volumes must be available as future upgrades, to allow charge-discharge cycling measurements on larger samples.
- The reactor must allow a refrigerated recirculating waterbath and connections to be retro-fitted for thermostating with enhanced stability ( $\pm 0.1$  °C or better) in the range 0 to +80 °C.
- The instrument must be upgradable to additionally allow dynamic flow mode operation, where dynamic flow mode includes the ability to flow an inert carrier gas (e.g. helium) through the sample bed at a programmable mass flow rate while continually sampling downstream with a mass spectrometer. The sample reactor must allow operation in both manometric and dynamic modes with optimized flow path for dynamic mode operation.
- The system must be upgradable for performing temperature programmed desorption (TPD) and related measurements in dynamic flow mode and allow connection to a downstream dynamic sampling mass spectrometer for real-time desorbed species identification and analysis.
- The system must be upgradable to allow operation in dynamic flow mode both at atmospheric pressure and also at elevated pressures up to 200 bar.
- The system must be upgradable with a close coupled dynamic sampling mass spectrometer to allow downstream gas analysis in dynamic mode. The mass spectrometer must be a quadrupole mass spectrometer with mass/charge range 1-200 amu and must have a dual Faraday / Electron Multiplier detector with sensitivity 100 ppb or better and response time 300 ms or better.

#### **Note:**

Bidder Should Provide details of Supplies made of similar equipment to different organization, as per Format 4.

Feedback will be taken from the customers from different organizations where the bidder has supplied the aforementioned equipment. The feedback of previous supply will be considered for technical evaluation.