

Specifications for Physisorption and Chemisorption Analyzer

Applications/ Purpose: To perform physisorption and chemisorption analysis of solid samples including heterogeneous porous catalysts, activated carbons, adsorbents, bio-char, other inorganics.

Compatibility: Single analyzer system should be compatible for physisorption and chemisorption analysis of the various materials.

1. Features for analytical system

- Automatic in-situ sample preparation for volumetric chemisorption.
- Ability to sequence multiple analyses on the same sample.
- The system should have multiple programming modes using a target P/P^0 or fixed volumes in multiple ranges.
- The maximum P/P^0 using N_2/Ar should be 0.999.
- The system must monitor the manifold temperature and pressure continuously.
- Degassing: At least two degassing stations should be operated simultaneously using different degassing protocols. The equipment must be capable of performing degassing and analysis, simultaneously.
- The system should have an automatic backfill facility from dedicated gas input or isolated under vacuum at the end of degassing.
- Fully integrated built-in/external vacuum system using an oil-free turbo pump.
- Degas station, software controlled degas system should allow multiple temperatures, ramp rates and degas times to be programmed, performed, stored as part of analysis parameters, and displayed in results.
- Five or more user definable analysis gas inlets.
- The equipment must be fully automated, supplied with all the accessories and features for samples preparation, as well as sample treatment.
- Equipment software should be Windows 7 O/S (or higher) compatible.
- The software should have the capability to perform a range of analysis as given below:
 - **For physisorption:** Specific surface area using single and multi-point BET, Langmuir, t-plot, BJH/DH, Dubinin-Radushkevich methods; Mesopore/micropore size distribution calculated using BJH/DH, Horvath-Kawazoe methods; Micropore volume and total Pore volume using Dubinin-Radushkevich/Dubinin-Astakhov, α -s, BJH/DH methods; Adsorption energy computed using the Clausius-Clapeyron or Dubinin-Radushkevich methods.
 - **For chemisorption:** Parameters such as active metal surface area of metal, percent metal dispersion, and average crystallite size should be estimated accurately; heat of adsorption and monolayer capacity; Extrapolation, Langmuir, dissociative Langmuir, Freundlich, Temkin should be employed to estimate chemisorption parameters.
 - The software should have the capability to generate professional reports, and the data should be exported to conventional file formats.

2. Operating Specifications:

Surface area range: 0.01 to 1200 m²/g or above
Pore size distribution: 3.5 to 5000 Å
Micropore volume: Detectable within 0.001 cc/g

3. Gases for analysis:

Physisorption- N₂, Ar,

Chemisorption- O₂, CO₂, CO, H₂, NH₃

4. Detailed specifications for

Physisorption- Continuous P⁰ monitoring

Pressure Accuracy: > 0.15% of reading

Pressure Measurement: 0 to 0.1 Torr

Degas System: Ambient to 350 °C or higher, with minimum 1 °C increment
(ramp range from 1 to 50 °C/min programmable)

System Capacity: 1 analysis, with minimum 2 degas ports.

Chemisorption-

System Capacity: 1 analysis port

Furnace temperature: 1000 °C or more and with minimum 1 °C increment
(programmable ramp range from 1 to 50 °C/min)

- 5. The following standard accessories/consumables should be supplied:** Surface area reference materials, chemisorption reference materials. Sample cells for physisorption and chemisorption. Other general chemisorption operating and physisorption operating supplies should be included.
- 6. Warranty:** Two years for the complete system from the date of installation
- 7. Training:** Comprehensive training should be provided to the users on method development, operation, troubleshooting the instrument while analysis of the materials.
- 8. Required feature:** The system should have the capability to be upgraded with a thermal conductivity detector with calibration loop option to perform TPR/TPD/TPO and pulse chemisorption.
- 9. Items to be quoted separately:**
- Gases and gas cylinders (UHP He, O₂, N₂, H₂ and CO) with regulators
 - Desktop computer of standard configuration with Windows 7 O/S or higher
 - Online UPS with batteries of a standard kVA capacity
 - Service AMC for instrument maintenance for 2 years
 - 10L liquid nitrogen dewar tank
 - Standard accessories/consumables like sample tubes, ferrules, O-rings, quartz wool
- 10.** The vendor should have installed a similar system in leading institutes and industries in India, and should include at least 5 performance certificates from the current users.
- 11.** For any technical clarifications, please contact Dr. Lakshmi Prasad Gurralla (Phone: 8978501768; gurrallalakshmi Prasad@gmail.com).