RuboSORP MSB

High-Pressure Sorption Analyzer

INTRODUCTION

"Unmatched Precision in Direct Sorption Measurements"

Accurate mass measurement is critical across materials science, chemical engineering, energy storage, and catalysis research. While traditional electronic microbalances offer high precision under standard laboratory conditions, they are often unsuitable for extreme environments involving high pressure, high temperature, or corrosive and reactive gases. The **Magnetic Suspension Balance (MSB)** addresses these challenges with contactless, high-resolution mass measurement in fully isolated, controlled environments.

The **RuboSORP MSB** employs a magnetically coupled weighing system that physically separates the microbalance from the sample atmosphere. This design allows for real-time gravimetric analysis under demanding conditions—without the need for purge gases or proximity protections—enabling accurate study of sorption processes, adsorption kinetics, vapor-liquid equilibria, and gas-phase density.

Figure 1. ***RuboSORP MSB***

Samples are housed within a sealed, corrosion-resistant chamber. Any change in mass is transmitted through a magnetic assembly to a high-precision microbalance operating at ambient pressure. This contact-free transfer ensures long-term stability, exceptional resolution, and minimal signal drift—even over extended experimental durations or during thermal cycling.

A standout feature of the **RuboSORP MSB** is its dual-sample capability. The system can simultaneously analyze two samples or substitute one with a calibrated sinker for direct gas density measurement via Archimedes' principle. This is especially valuable in high-pressure or multi-component gas systems where conventional equations of state fall short.

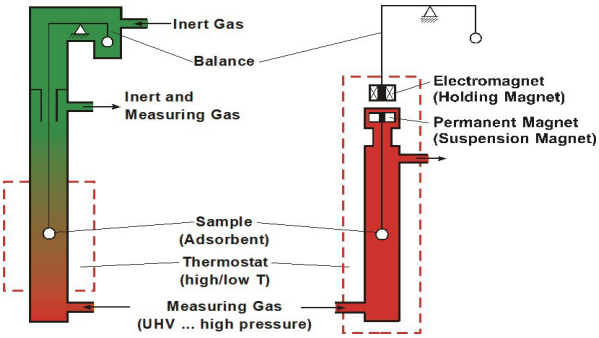
Applications Include:

- Adsorption kinetics and isotherms
- High-pressure hydrogen and methane storage
- Gas-liquid phase equilibrium analysis
- Carbon capture and sequestration studies
- Competitive and multi-component gas adsorption
- Thermogravimetric analysis of volatile and reactive samples

Comparison of Traditional Balance and Magnetic Suspension Balance

Conventional Microbalance

The measuring cell of a traditional thermal balance is physically connected to the electronic balance for measurement. The electronic microbalance requires protection by an inert purge gas to isolate the effects of water vapor, corrosive gases, and high temperatures in the measuring gas on the microbalance. However, the presence of purge gas and temperature gradients unavoidably impacts the experimental process. As a result, traditional thermal balances are typically only suitable for applications in dynamic atmospheric environments.



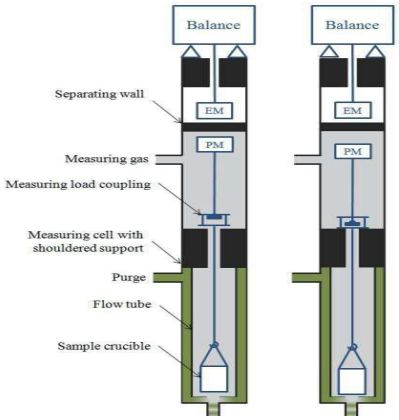
Magnetic Suspension Balance

The sample measurement area of the magnetic suspension balance is completely isolated from the peripheral electronic microbalance and is not physically in contact with it. Therefore, the suspension balance can be used in almost all processes. Temperature or pressure does not pose any threat to the measurement of the magnetic suspension balance. The reactor of the magnetic suspension balance is made of completely corrosion-resistant metal materials and is sealed. Therefore, measurements in high temperature, corrosive media, and from vacuum to high pressure environments are all feasible.

KEY FEATURES

Automatic Drift Correction & Recovery

The **RuboSORP MSB** actively compensates for pressure and temperature-induced drift, maintaining accurate readings throughout adsorption, desorption, or thermal cycles. A built-in self-recovery system prevents data loss in case of unexpected motion or imbalance, ensuring uninterrupted experiments.



Modular Design & Flexible Configuration

The **RuboSORP MSB** features a fully modular setup with interchangeable components for pressure, temperature, gas dosing, and reactor control. Visual cells, custom sample holders, and a range of heating options—from cryogenic to high-temperature—ensure adaptability to diverse applications.

Smart Software & Data Integrity

Automated control software manages all experimental parameters in real time and includes built-in uncertainty analysis. It supports ISO 9001 and GUM standards, generates adsorption curves on the fly, and logs data in accessible formats for seamless analysis and reporting.

Sealed Coupling Chamber

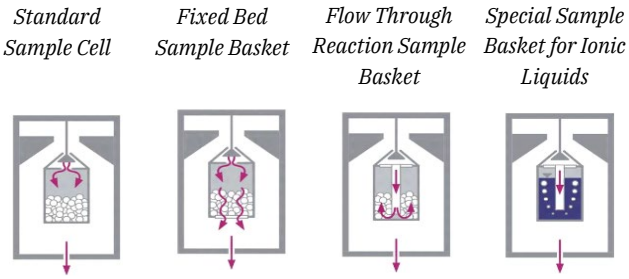
Enables safe use of toxic, reactive, and corrosive fluids—allowing experiments to be conducted under real-world conditions without compromising balance integrity.

KEY FEATURES (cont.)

Density / Double Sample Measurement
The dual sample measurement module enables experiments with two samples simultaneously. One position can be fitted with an inert float or calibrated sinker, allowing direct measurement of gas density via Archimedes' principle—especially critical at high temperatures and pressures where traditional equation-of-state methods become unreliable. This capability is particularly valuable in multi-component gas adsorption studies, as it enables real-time tracking of composition changes without the need for external gas analysis tools such as chromatography.

Optional Viewing Cells
Optional high-pressure viewing cells provide in-situ visual access to the sample chamber, enabling direct observation of swelling behavior, phase transitions, and vapor–liquid equilibrium phenomena. A high-strength window allows monitoring of expansion and adsorption processes in polymer and ionic liquid samples through an integrated image acquisition system. The system operates reliably under extreme conditions, with a maximum temperature of 200 °C and pressure up to 35 MPa.

Figure 2. Optional Viewing Cell



Customizable Sample Cells and Reaction Baskets
To simulate real-world reaction conditions, AMI offers a range of interchangeable measuring cells and sample basket modules. Sample cell dimensions—up to 70 mm in diameter—can be customized to suit various materials and experimental needs. AMI also provides tailored solutions, including the development of new basket designs based on customer requirements. Available options include FF-type fixed bed baskets, FT-type high-efficiency reaction baskets, and specialized baskets designed for ionic liquids.

Industry-Leading Sample Capacity
Supports the widest max sample capacity, accommodating large or irregular samples without compromising accuracy—ideal for heterogeneous materials and custom applications.

Exceptional Stability Over Time
The system uses a load decoupling mechanism to periodically remove the sample from the balance, perform automatic recalibration, and resume the experiment—ensuring long-term measurement stability and eliminating drift during extended runs.

GAS CONTROL AND PRESSURE SYSTEM

The **RuboSORP MSB's** gas system is equipped with two high-precision pressure sensors: a sensor with a range to 5 MPa and a sensor with a range to 40 MPa, both with an accuracy of 0.01 bar

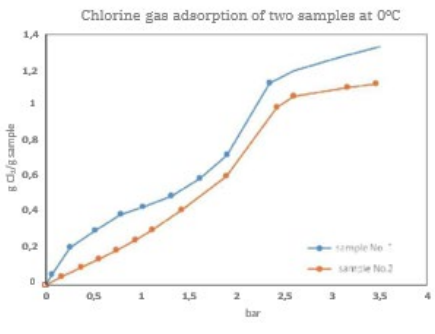
Gas System Models:

System Type	Model No.	Pressure Range (bar)	Temperature Control	Inlets	Option
Dynamic Gas System	GDU-150D-A	150	none	2	Mechanical pump / Molecular pump / Vapor dosing / Extra gas path / Additional pressure sensor
	GDU-150D-H	150	100 °C	2	
	GDU-350D-A	350	none	2	
	GDU-350D-H	350	100 °C	2	
Static Gas System	GDU-150S-A	150	none	2	Mechanical pump / Molecular pump / Vapor dosing / Extra gas path / Additional pressure sensor
	GDU-150S-H	150	100 °C	2	
	GDU-150S-H mix	150	100 °C	3	
	GDU-350S-A	350	none	2	
	GDU-350S-H	350	100 °C	2	
	GDU-350S-H mix	350	100 °C	3	
	GDU-700S-A	700	none	2	
	GDU-700S-H	700	100 °C	2	
	GDU-700S-H mix	700	100 °C	3	

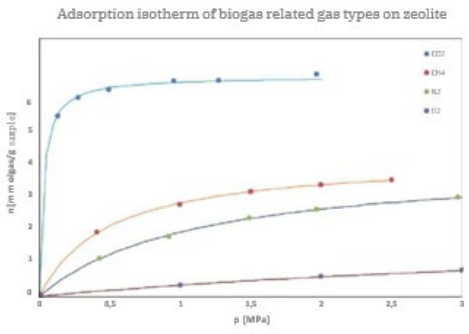
TYPICAL DATA ANALYSIS

The **RuboSORP MSB** can measure various types of gas adsorption isotherms, determine adsorption isobars, obtain adsorption kinetics curves, and conduct multi-component competitive adsorption.

It can handle all common gases, including but not limited to hydrogen, nitrogen, methane, carbon monoxide, carbon dioxide, and oxygen, as well as corrosive gases such as: chlorine, hydrogen sulfide, and sulfur dioxide. Additionally, it can be paired with a visual measurement module or a separate visual observation module to study the absorption or volume change of supercritical carbon dioxide.



Corrosive gas Cl_2 adsorption test results



High pressure adsorption curves of molecular sieve for nitrogen, methane, hydrogen and carbon dioxide

Application of two-component competitive adsorption

For the study of competitive adsorption of two-component gases, AMI offers an ingenious solution, which is to measure the density of the gas mixture at adsorption equilibrium in real time through a special three-position Magnetic Suspension Balance, and then calculate the adsorption amount of each gas in the two component gas in real time through software, without the need for external chromatography/mass spectrometry tools.

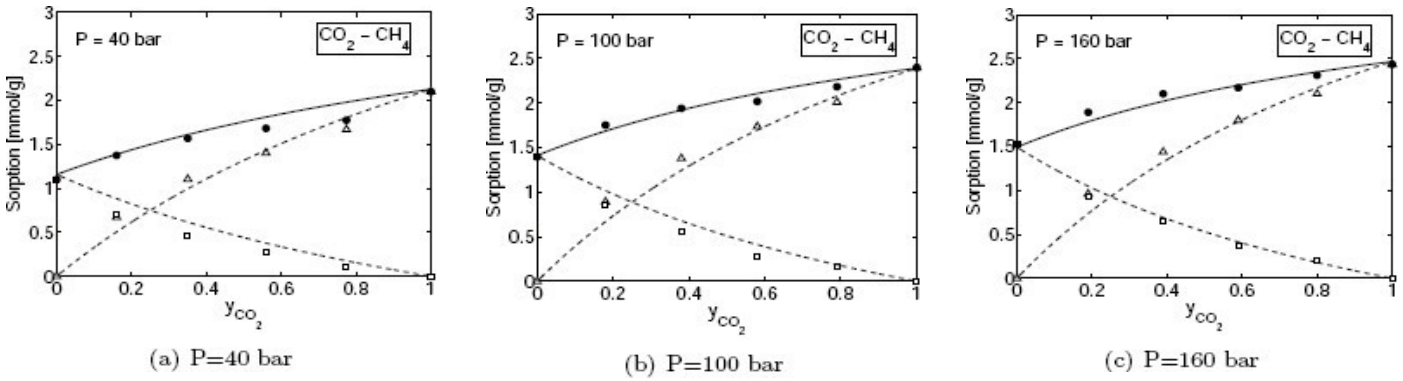


Figure 3. Sulcis coal sample carbon dioxide/methane binary competitive adsorption data

SPECIFICATIONS

Model	Max Pressure	Max Temperature	Max Sample Loading	Resolution	Vacuum Option	GDU Capability	View Cell & Camera Option	Model
MSB-150	150bar	400°C	25g	10µg	Yes	Dynamic or Static	Yes	MSB-150
MSB-150	150bar	400°C	50g	10µg	Yes	Dynamic or Static	Yes	MSB-150
MSB-150	150bar	400°C	10g	1µg	Yes	Dynamic or Static	Yes	MSB-150
MSB-350	350bar	400°C	25g	10µg	Yes	Dynamic or Static	Yes	MSB-350
MSB-350	350bar	400°C	50g	10µg	Yes	Dynamic or Static	Yes	MSB-350
MSB-350	350bar	400°C	10g	1µg	Yes	Dynamic or Static	Yes	MSB-350
MSB-700	700bar	150°C	25g	10µg	Yes	Static Only	No	MSB-700
MSB-700	700bar	150°C	50g	10µg	Yes	Static Only	No	MSB-700
MSB-700	700bar	150°C	10g	1µg	Yes	Static Only	No	MSB-700

APPLICATIONS

Hydrogen & Methane Storage

High-pressure isotherms provide real-world data critical for evaluating advanced storage materials including MOFs and metal hydrides.

Corrosive Gas Research

Quantify adsorption of SO_2, HF, Cl_2, and similar aggressive gases at controlled temperature and pressure—safely and accurately.

Supercritical CO_2 Studies

Track sorption behavior and reaction kinetics in polymers, biomass, or coal under supercritical conditions with full visual feedback and gas-phase density measurement.

Multi-Component Adsorption

By integrating a calibrated gas mixer, the MSB measures real-time competitive adsorption of gas mixtures, eliminating the need for offline chromatography.

RuboSORP TGA

High-Temperature and High-Pressure Magnetic Suspension Thermo-gravimetric Balance

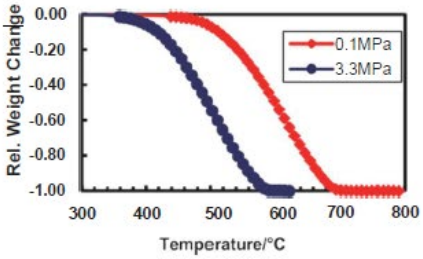
Thermogravimetric analysis is a well-known method for analyzing material properties in materials science, physics, and chemistry. By measuring the weight change curve of a sample under controlled temperature and pressure conditions, valuable information about chemical reactions, structural changes, and thermal stability can be obtained. AMI's patented high-precision magnetic suspension balance can accurately measure sample weight changes without contact and perform weighing under extreme conditions, such as ultra-high temperatures (1200°C or higher), high pressures (50 bar or higher), corrosive atmospheres (e.g., hydrogen sulfide, sulfur dioxide), toxic atmospheres (e.g., thioethers), and environments with water vapor or organic vapors (e.g., benzene, alcohol).

Dispensing position: The sealing flange is open, and the balance head is raised for dispensing.

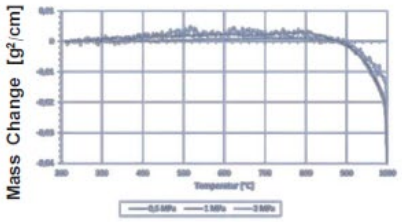
Measuring position: Sealing flange locks for data measurement.

APPLICATION EXAMPLES

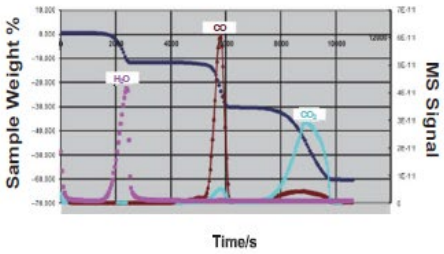
The Magnetic Suspension Balance High-Pressure Thermogravimetric Analyzer is fully customizable to meet specific experimental requirements. It is designed for analyzing the thermal characteristics of various materials such as coal, biomass, oil shale, catalysts, and composites under programmed heating conditions. This advanced system includes a high-pressure, high-temperature quality monitoring setup that enables research into pyrolysis, gasification, oil cracking of materials, as well as catalyst activation, corrosion, and activity under high-temperature, high-pressure, reducing atmosphere, and water vapor environments. The analyzer supports both fundamental and applied research, focusing on areas such as coal quality conversion, coal tar deep processing, and the efficient utilization of biomass and industrial solid waste.



Coal gasification research
The gasification process of anthracite coal at different pressures is measured in a mixture of O_2 and N_2 at a concentration of 2%. At higher pressures, the gasification of coal can be completed at lower temperatures.



Long-term corrosive studies
Measuring the thermogravimetric curves of a graphite material sample at three different pressure levels, a significant vaporization process occurs after 800 °C.



Thermogravimetric mass spectrometry
Thermogravimetric curve of calcium oxalate, coupled with mass spectrometry.

FLUID AND PRESSURE CONTROL

High temperature and high pressure thermobalance

GDU Gas/Vapor pressure control system

The system features fully automated gas/steam flow and pressure control. Pair it with a gas analysis method like chromatography, mass spectrometry, or infrared to enable combinations such as:

Thermogravimetric-Chromatography

Thermogravimetric-Mass Spectrometry

Thermogravimetric-Gas Chromatography

Thermogravimetric-Infrared.

Magnetic suspension thermobalance	Gas system	Pressure range	Fluid type	Gas-dosing	Special function
RuboSORP TGA LP	G-LP DYN	1 bar	Gas	Dynamic	High vacuum
	G&V-LP DYN	1 bar	Gas/Steam	Dynamic	Gas constant temperature pipeline
RuboSORP TGA MP	G-MP DYN	50 bar	Gas	Dynamic	Basic model
	G&V-MP DYN	50 bar	Gas/Steam	Dynamic	HPLC Introduction of steam
RuboSORP TGA HP	G-HP DYN	150 bar	Gas	Dynamic/Static	Two-stage pressure control
	G&V-HP DYN	150 bar	Gas/Steam	Dynamic/Static	HPLC Introduction of steam
	G-HP II DYN	350 bar	Gas	Dynamic/Static	Two-stage pressure control
	G&V-HP IIDYN	350 bar	Gas/Steam	Dynamic/Static	HPLC Introduction of steam