AMI-300 Series

Fully Automatic Chemisorption Analyzer/ Catalyst Characterization Instrument

INTRODUCTION

"Complete Chemisorption & Reactor Solutions-Precision Without the Premium"

The **AMI-300** is the flagship model in AMI's line of fully automated chemisorption analyzers, designed specifically by-and-for-catalyst researchers. Expanding on the groundbreaking AMI-1—the industry's first instrument to deliver fully automated dynamic chemisorption techniques in a single, integrated system—the **AMI-300** enhances and advances this innovation, offering even greater capabilities and performance. Engineered with our proven chemisorption platform, the **AMI-300** performs all major dynamic techniques required for comprehensive catalyst characterization, with precision, reliability, and ease of use.

The **AMI-300** Series is also highly customizable to meet the specific needs of advanced research and industrial applications. From variable pressure ranges and multiple analysis stations to specialized software functions, Advanced Measurement Instruments (AMI) can tailor each system to meet the most stringent experimental requirements.

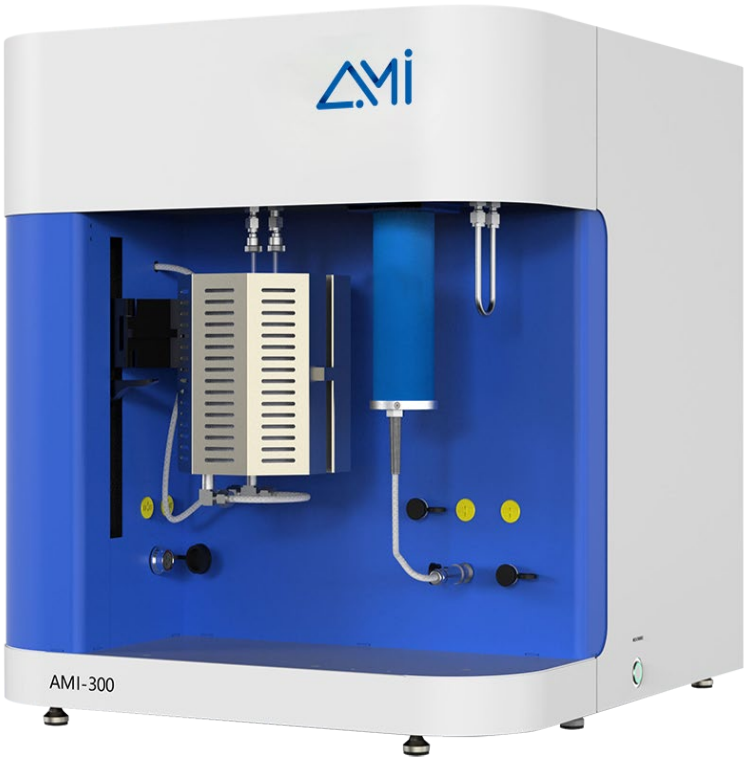

*Fig.1 Structural diagram of **AMI-300 Series***

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Whether you're conducting routine catalyst testing or advanced R&D, the **AMI-300** delivers the flexibility, control, and automation your lab demands with the following functions:

- ✓ **Pulse Chemisorption**
  Quantify active metal dispersion and surface area with precise gas pulsing control.
- ✓ **Temperature-Programmed Reduction (TPR)**
  Evaluate reducibility and metal-support interactions.
- ✓ **Temperature-Programmed Oxidation (TPO)**
  Characterize oxidation behavior of reduced catalysts and carbon deposits.
- ✓ **Temperature-Programmed Desorption (TPD)**
  Analyze desorption strength and binding energies of surface species.
- ✓ **Temperature-Programmed Surface Reaction (TPSR)**
  Study surface reactivity under reactive gas environments.
- ✓ **Flow BET Surface Area Analysis**
  Determine surface area using dynamic nitrogen physisorption.
- ✓ **Pretreatment and Activation Routines**
- ✓ **Calibrations and Standards Handling**
  Link up to 99 individual procedures into a single automated experiment
- ✓ **Safety: A Three-Layered Approach**
  The AMI-300 is built with a comprehensive, three-layered safety system that protects both users and equipment at every level of operation.

  1. **Hardware Safety**
     Independent Over-Temperature Protectors on the furnace prevent thermal runaway.
     Resealable Pressure Relief Valves automatically vent excess pressure and reseal without damage.
     Check Valves prevent backflow and protect against gas cross-contamination.
     Fail-Safe Design ensures the system defaults to a safe state during critical failures or power loss.
  2. **Firmware-Level Protections**
     Embedded logic continuously monitors temperature, flow, and pressure in real time.
     Interlocks and thresholds ensure safe operation limits are never exceeded.
  3. **Software Alarm Matrix**
     A dynamic alarm matrix provides live feedback and alert notifications for all monitored parameters.
     Visual and audible alarms guide users through corrective actions.
     Logging of alarm events ensures traceability and compliance with lab safety protocols.

KEY FEATURES

Electronic Flow Controllers
The system is equipped with high-quality linear mass flow controllers for precise and stable gas flow control, ensuring accuracy in chemisorption applications. The standard flow range is 0–100 sccm, with additional ranges available upon request for customized setups. These controllers offer excellent linearity and repeatability, providing reliable and consistent gas dosing throughout all programmed procedures.

Sensitive Thermal Conductivity Detector
A highly reliable 4-filament thermal conductivity detector (TCD) is used to accurately quantify gas uptake. It offers excellent linearity, accuracy, sensitivity, and long-term stability. Multiple filament configurations are available to suit different analytical needs and gas types.

Precision Gas Control with Independent MFCs and Blending
The AMI-300 features three mass flow controllers (MFCs) for independent control of carrier, treatment, and auxiliary gases, with an optional fourth MFC for advanced setups. It supports internal gas blending for precise atmosphere control, and an auxiliary gas inlet can mix with carrier or treatment gases as needed. Rear-panel gas ports simplify access, with four each for treatment and carrier gases, two auxiliary/blending ports, and up to 12 total ports, ensuring versatility for chemisorption applications.

Low internal volume and Heated Lines
Low volume valves and 1/16" lines are used to reduce void volume and minimize peak spreading. All lines, valves, and parts of the liquid Vaporizer are heated to prevent condensation.

High-Temperature Furnace
Features a versatile furnace system capable of reaching temperatures up to 1200°C. With optional sub-ambient cooling, the system can achieve temperatures as low as -130°C, making it suitable for a wide range of thermal and catalytic applications. The furnace supports linear temperature ramping from 0.1°C per minute to 50°C per minute, allowing precise control over heating profiles for reduction, oxidation, desorption, or reaction studies

Various sample holders
The AMI-300 is the only system on the market that enables direct analysis of monolith samples (with an optional monolith holder), in addition to supporting a variety of quartz U-tubes—including standard, bubble, and custom designs. It accommodates a wide range of sample forms and loadings, such as powders, pellets, extrudates, and honeycomb cores, making it exceptionally versatile for real-world catalyst testing and development.

Interchangeable valve loops
A set of 13 optional injection loop modes provides an easy and flexible way to meet the adsorption volume requirements of different sample types. Available upgrades include microliter loops in 5, 10, 15, 20, 23, 50, 100, 250, and 500 µL sizes, as well as milliliter loops in 1, 2, 5, and 10 mL volumes. These options ensure precise dosing for both low and high surface area materials across a wide range of applications.

Materials for Maximum Durability
Seals and materials are designed to meet your specifications, with options that include premium elastomers (Kalrez), passivated 316 stainless steel, Monel or Hastelloy valves, and Inconel reactors.

Precise Sample Temperature Measurement
Sample temperature can be measured or controlled by either the furnace thermocouple or a movable thermocouple positioned at the top of the sample bed, offering flexibility and precision for various experimental needs.

Rapid Air cooling
The system rapidly cools the furnace, enabling quick sample turnaround and increased throughput for busy laboratories.

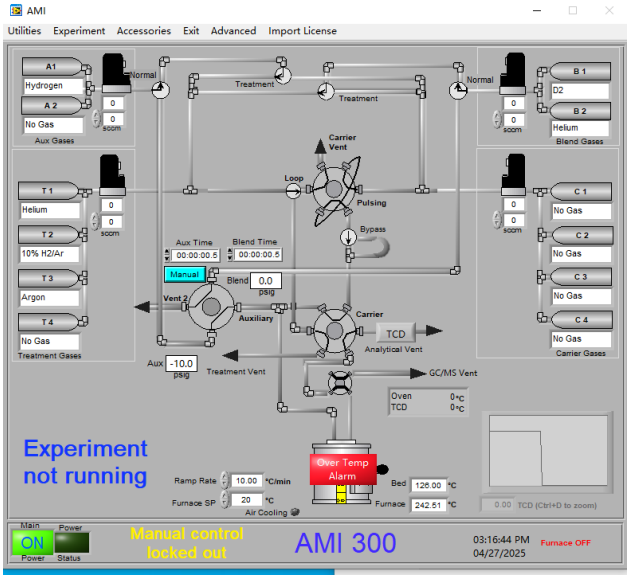
Cold Trap
A cold trap downstream of the sample holder protects the TCD from moisture and condensable vapors. It features a Dewar flask for slurry-based condensation or a desiccant option for low-volatility experiments, ensuring a stable baseline, extended detector life, and reliable TPR, TPO, and dynamic measurements.

SOFTWARE

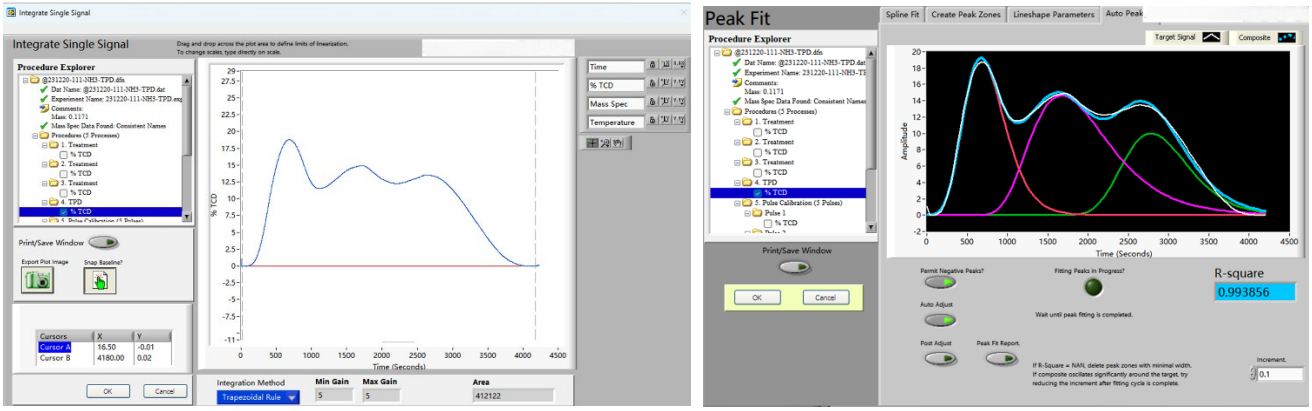
The **AMI-300** features an intuitive and clearly structured interface, with a well-organized graphical display and logical operational flow. This design dramatically reduces the learning curve, making the system easy to navigate for both new and experienced users.

Operation is simplified and streamlined, minimizing the risk of user error while ensuring smooth, consistent experimentation. The software provides comprehensive process monitoring, with real- time status indicators and fully traceable data logging for enhanced reliability and experimental control.

In addition to control and monitoring, the **AMI-300** offers advanced data processing capabilities, including peak fitting, peak separation, integration, differentiation, and overlay analysis. These powerful tools enable precise characterization of catalyst surface properties, distribution of acidic and basic sites, activation energy, reaction kinetics, and more—delivering deep insight into complex catalytic behaviors.



Figures 2. Software analysis interface



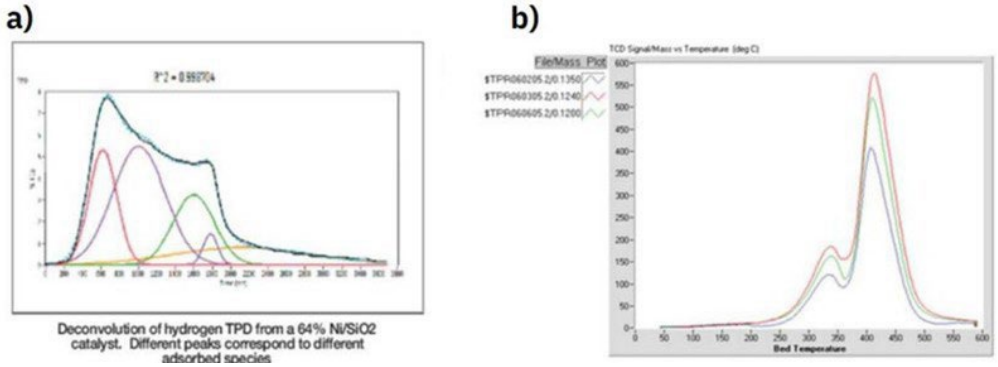
Figures 3-4. Software analysis interface

APPLICATIONS

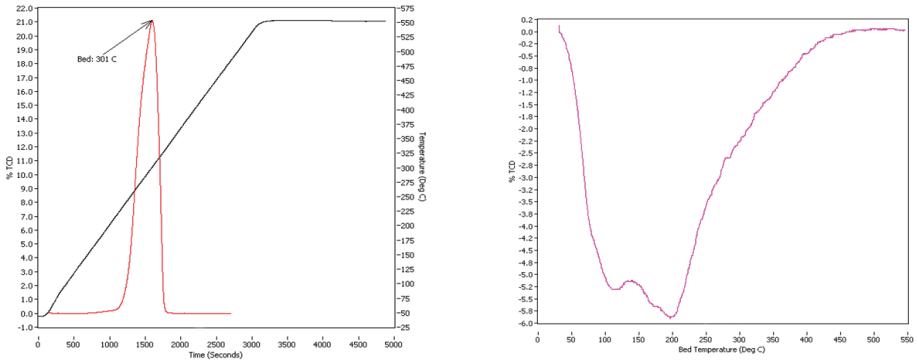
Understanding the number of active sites, surface structure, and related properties-such as acidity/basicity, activity, selectivity, stability, and deactivation behavior-is essential for optimizing industrial reaction processes. In catalytic, chemical, and petrochemical industries, including fine chemicals, fuels, fertilizers, green catalysts, lithium-ion batteries, fuel cells, and emerging energy storage materials, surface activity is a key driver of performance and innovation.

Heterogeneous catalysts play a central role in critical industrial applications such as catalytic cracking, hydrogenation, selective oxidation, reduction, automobile exhaust treatment, isomerization, oxygen storage capacity (OSC), Fischer-Tropsch synthesis, and coal chemistry, among others.

At AMI, we advance catalytic material surface characterization with powerful, user-focused tools. With instruments like the **AMI-300,** we equip scientists and catalyst developers with precise, automated solutions to solve real-world challenges.



Deconvolution of hydrogen TPD from a 64% Ni/SiO2 catalyst. Different peaks correspond to different adsorbed species



CuO TPR Ni Silica TPD

Figure 6. Analysis interface, a) automatic peak separation and fitting, b) multiple data for comparison, c) TPR experimental results of CuO, d) TPD experimental results of Ni Si.

SPECIFICATIONS

	AMI-300
Catalyst charge	0.1-5 g
Temperature range	RT - 1200°C -130°C (optional) to 1200°C
Ramp rate	0.1-50°C/min
Operating pressure	Atmospheric pressure or up to 100 bar (optional)
Gas input	10 inlets standard (12 optional)
Gas flow rates	2-100 sccm
Reactor types	Quartz u-tubes 1/4", 3/8", 1/2"optional
Detector	Standard Tungsten Rhenium filaments (can change with options), temperature up to 200°C
Materials of construction	Kalrez, 316SS
Dimensions	W: 22.1 in (56 cm) × H: 23.6 in (60 cm) × D: 24.0 in (61 cm)
Weight	106 lbs (48 kg)
Mass flow controllers	3 (4 optional)
High-temperature oven	Up to 150°C
Vapor generator	Optional
FTIR	Optional
Mass Spectrometer	Optional
FID	Optional
Harsh-Service	Allows for high-percentage sulfur compounds (S & S Plus models)
SSITKA	Optional

AMI-SSITKA

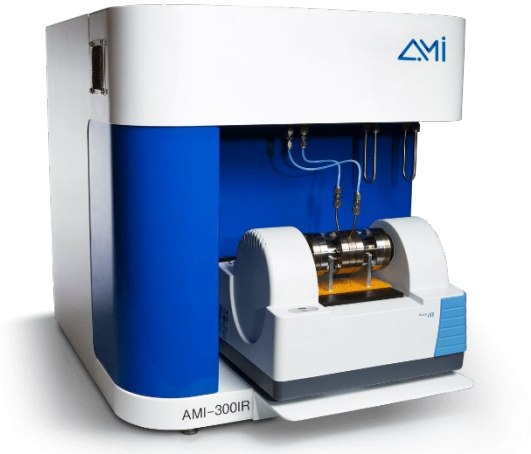
Steady-state isotope transient kinetic analysis (SSITKA) is a powerful method for studying the kinetics and mechanisms of heterogeneous catalytic reactions. It provides both qualitative insights into reaction mechanisms and quantitative in-situ kinetic data, including intermediate species coverage, surface lifetimes, rate constants, and active site distribution. To meet user needs, we have developed the AMI-300TKA series, leveraging years of expertise to deliver reliable and efficient testing equipment for SSITKA studies.

AMI-300IP

The developer of AMI has developed a more efficient AMI-300IP based on the concept of user perspective. This model has two separate heating furnaces that allow the first sample to be tested while the second sample is being pretreated. When the first sample completes the test, the test program for the second sample automatically starts running. This method greatly improves the efficiency of the instrument.

AMI-300IP is the best choice when samples have very long pretreatments and the need for throughput is high.

AMI-300IR



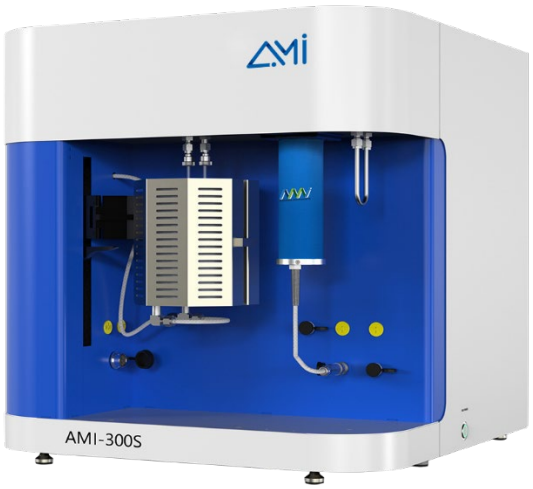
Chemisorption and thermal desorption techniques, such as TPD, are widely used for catalyst characterization by detecting evolved gases with a thermal conductivity detector (TCD) or a mass spectrometer. While these methods reveal the number and strength of active sites, they do not provide information on site nature, adsorption type, or the presence of multiple site types.

To overcome these limitations, the AMI-300IR integrates standard AMI techniques with real-time FTIR spectroscopy. This combination enables direct observation of adsorbed species on the catalyst surface, providing deeper insights into adsorption mechanisms and expanding the understanding of catalytic behavior.

AMI-300HP

AMI-300HP is a high temperature and high pressure chemisorption analyzer developed based on AMI-300 to meet higher scientific research needs. In addition to the basic experiments that can be done with AMI-300, the performance of the catalysts can be further investigated at high pressures. This type of instrument can be tested at atmospheric pressure up to 100 bar.

AMI-300S – HC Design



The AMI-300S is optimized for catalyst pretreatment and chemisorption workflows in chemically aggressive environments. With its HC (Harsh Chemistry) design, the system handles corrosive gases and reactive conditions without compromising performance. In addition to TPR, TPD, TPO, and pulse chemisorption, the AMI-300S includes hardware for sulfidation treatments, making it ideal for hydroprocessing catalyst research and sulfur-sensitive materials.

AMI-300SPlus – HC Design

The AMI-300SPlus builds on the AMI-300S by adding temperature-programmed sulfidation (TPS) for advanced catalyst preparation and surface reactivity analysis. Its HC (Harsh Chemistry) flow path ensures durability during prolonged exposure to sulfur-containing gases and acid-rich environments. The 300SPlus is a complete solution for research labs working with demanding chemical processes.

Our HC (Harsh Chemistry) systems are engineered for demanding applications involving highly corrosive or reactive chemical environments. Using corrosion-resistant alloys, chemically inert flow paths, and reinforced sealing components, HC platforms are built to perform reliably where standard systems fail.

- HC designs are compatible with exposure to:
- NOx and reactive nitrogen species
- High-percentage ammonia streams
- Mercury and other heavy metal vapors
- Halogenated VOCs (e.g., chlorinated and fluorinated compounds)
- Aggressive acids including HCl, H_2SO_4, and HF

Whether used in environmental analysis, catalyst preparation, or advanced materials research, HC systems deliver long-term durability, minimized contamination risk, and consistent analytical performance under the harshest conditions.