RUBOLAB

RuboCAT

- 1 MPa
- 1100 °C
- Dosing of 4 Gases
- Vapour Generation
- Catalysis, TPD, TPR,
  Pulsed Chemisorption, Breakthrough Curve

Background

Catalytic reactions are the basis of many chemical and petrochemical processes. They are used, for example, in ammonia synthesis or in oil refineries to produce petrol. In heterogeneous catalysis, the catalyst and the substances required for the reaction are present in different phases: Reactants are usually liquid or gaseous, while a solid substance is often used as catalyst. Different measuring methods are available for the characterization of the corresponding catalysts. Instruments of the **RuboCAT** series enable reliable and flexible characterization with all common methods.

The Instrument

Instruments of the **RuboCAT** series stand out due to their compact design and functionality, which can be customized according to specific requirements. The main features are including:

High-precision mass flow controllers

Four thermal mass flow controllers are working within a flow range between 2 and 100 ml_n/min. Other flow rates are available on request.

High-pressure measurements of up to 1 MPa

The instrument is equipped with a back-pressure regulator, providing the opportunity to generate dynamic gas atmospheres of up to 1 MPa.

Humidity control included

The standard version already contains a saturator which can generate humidified gas flows. By adjusting flow rate and temperature, different levels of relative humidity can be achieved.

Highly accurate vapour dosing (option)

In addition, the instrument can be equipped with a highly accurate vapour dosing system using a HPLC pump in combination with an evaporator cell. Any condensable fluids are removed before the pressure regulator by means of an integrated cooling trap.

Wide temperature range

The reactor is temperature controlled within a range between 25 and 1100°C using heating rates of up to 25°C/min.

Pre-heated reactor inlet

Especially in high-pressure regions, the gas flow can lead to an inhomogeneous temperature distribution within the reactor. For compensation, the gas flow is preheated electrically before reaching the reactor.

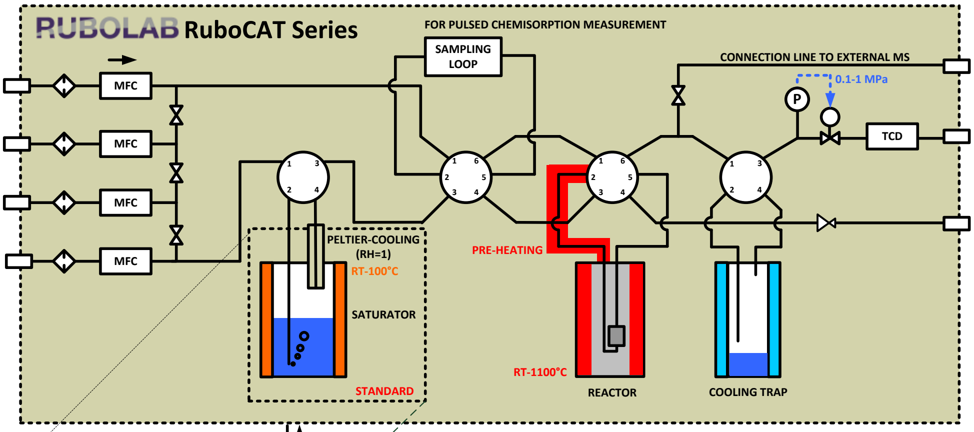
Integrated TCD sensor

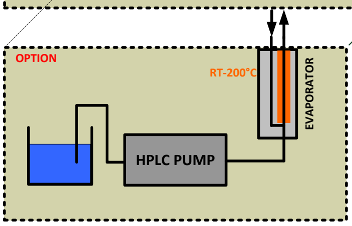
The standard version is already equipped with a thermal conductivity sensor being used for analysis of the dry gas composition.

Integration of mass spectrometer (option)

Additionally, the instrument can be paired with a mass spectrometer, ensuring even higher precision for analysis of the fluid composition. This optional mass spectrometer also makes the analysis of vapour fractions possible.

Flow Sheet



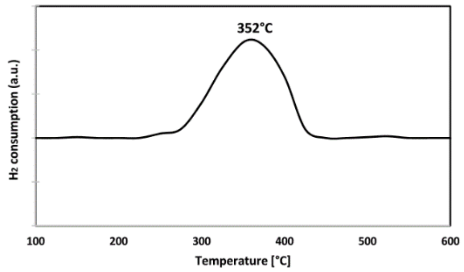


Please note:

This is only a simplified flow sheet for illustration of general workwise of the instrument

Executable Measurements, Applications

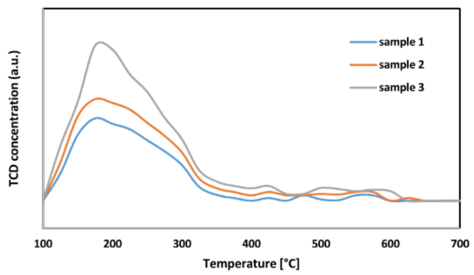
Temperature-programmed reduction (TPR)



TPR is used to investigate the reducibility or thermal behavior of catalysts as a function of temperature. Usually H_2 is used as reductant. The figure shows the TPR data measured for a nickel oxide sample (NiO), according to:

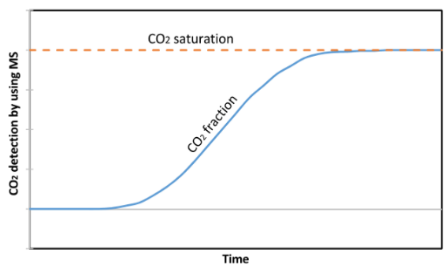
$$NiO + H_2 \rightarrow Ni + H_2O$$

Temperature-programmed desorption (TPD)



The binding energy of the adsorbate phase can be determined by means of a TPD measurement. A material previously loaded with adsorbate is heated under defined conditions, which leads to desorption of the previously adsorbed molecules. The desorption is detected by downstream analytics (TCD or MS).

Breakthrough Curve (BTC)



The measurement of breakthrough curves is a commonly used method for the evaluation of adsorption capacity and corresponding kinetics: A gas mixture (e.g. CO_2-N_2) flows through an adsorber filled with the sorbent. First, the preferred adsorbing component will be adhered by the material. After saturation, the component breaks through and is detected by suitable gas analysis.

Number of gas inlets		4
Flow range of each gas MFC	ml_n/min	2 to 100 (other on request)
Gas types		He, Ar, CO_2, H_2, CH_4, NH_3 and others
Pressure range	MPa	0.1-1
Accuracy of pressure detection	% F.S.	0.5
Temperature range	°C	25 to 1.100
Temperature sensor		Type K thermocouple
Pre-heating to avoid cooling effects in reactor		yes
Temperature ramp	°C	1 to 25
Humidity generation		Integrated via saturator
Vapor generation		Optional, HPLC pump and evaporator
Vapor type		H_2O, toluene, benzene and others
Temperature controlled chamber		Yes, for anti-condensation
Reactor size, sample holder (diameter)*	mm	5 to 10
TCD (thermal conductivity detector)		Integrated
MS (mass spectrometer)		Available as option
Volume of sampling loop (pulsed chemisorption)	ml	up to 10, customized
Dimensions (W x H x D)	mm	890x630x500
Power supply		AC 110V/220V
Gas connections		1/8” or 3mm Swagelok™

* can be adjusted according to customers specifications

CONTACTS

For further information about our products please contact our head office or the corresponding local distributor.

For more detailed information about our sales network please visit www.rubolab.de/distributors

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