



# Determining the Properties of Materials

Vacuum Solutions for  
Measuring Instruments



Figure 1: Duo 1.6 rotary vane pump from Pfeiffer Vacuum in use on a surface analyzer from Micromeritics GmbH.

For countless production processes and different end products, it is enormously important to know exactly the properties of the materials that are used. For this reason, the materials used in manufacturing processes, such as in the chemical industry, in process engineering, in the food and pharmaceutical industry, in the geosciences and in materials research are precisely characterized. Properties that are determined include the density, particle size distribution, porosity, pore size distribution as well as the specific surface area or the reactivity of catalysts. In order to analyze these and many other material properties, it requires reliable, highly accurate measuring instruments. Vacuum is one of the basic requirements for the function of these instruments and it is used for sample preparation and the evacuation of the sample during analysis.

#### **Expert for measuring instruments for material characterization relies on Pfeiffer Vacuum**

Micromeritics GmbH in Aachen is the German subsidiary of Micromeritics Instrument Corporation with its headquarters in Norcross, Georgia. The company is one of the leading manufacturers of instruments for the characterization of different materials. It develops special measuring instruments for the analysis of the following material properties:

- Particle size and shape
- Density
- Porosity, for example, in catalysts, building materials, ceramics, pharmaceuticals, metal powders, membranes or active components in batteries
- Determination of quality characteristics of excipients and active substances in medicinal products
- Electrode analysis and porosity measurements on lithium-ion batteries
- Analysis of specific surfaces
- Determination of the properties of manufacturing materials and powders used in 3D-printing

**For many of their processes the metrology expert Micromeritics GmbH relies on solutions from Pfeiffer Vacuum**

The metrology expert relies on Pfeiffer Vacuum's products for a large number of these processes. DuoLine rotary vane pumps are used in sample preparation and physisorption measurements. The samples in the measuring vessel are evacuated and freed from interfering volatile deposits under

medium vacuum and elevated temperature. This requires vacuum conditions in the pressure range up to  $10^{-2}$  mbar. The sorption is measured by dosing a sorptive gas at a constant temperature (for example,  $N_2$  at 77 K, i.e.  $-196^\circ C$ ). If the dead volume and also the metered gas quantity and the pressure are known,

the proportion of the gas adsorbed on the material surface can be calculated across the entire pressure range. This creates an isotherm. Theoretic models for surface adsorption by gas molecules (BET [Brunauer Emmett Teller], Langmuir, BJH [Barrett-Joyner-Halenda], etc.) are used to calculate the specific surface area and pore size distributions from these datasets.

In addition to the Pfeiffer Vacuum rotary vane pumps for vacuum generation, gas analyzers of the OmniStar series are also used. Its main field of application is chemisorption. If several products are formed through chemisorption reactions, it is no longer possible to distinguish between the reactive gas and the by-products. This is where gas analysis with the OmniStar helps to qualitatively differentiate and quantify the gas species.

#### **Pfeiffer Vacuum's product features are convincing**

The vacuum equipment requirements for the Micromeritics GmbH measuring instruments are high: Reliability, long service intervals and a low noise level are the most important criteria for the equipment selection. Pfeiffer Vacuum products are ideal for meeting these requirements. In addition, the close personal exchange between the customer and the vacuum experts from Pfeiffer Vacuum as well as the convincing price-performance ratio are additional major advantages.

#### **Vacuum solutions in use at Micromeritics GmbH**

Duo 1.6 rotary vane pump

- Two-stage rotary vane pump with pumping speed up to 1.5 m<sup>3</sup>/h.
- With 1-phase motor
- Integrated gas ballast and safety valve
- For all applications in the low and medium vacuum range
- Special features: Wide range of application due to different motor voltages
- Additional motor voltages available on request
- Optionally with magnetic coupling

OmniStar gas analyzer

- Consisting of inlet system, PrismaPlus mass spectrometer, MVP dry diaphragm vacuum pump and HiPace turbopump
- Heated and temperature-controlled gas inlet system
- Qualitative and quantitative analysis of gases
- Low detection limit (< 1 ppm) even for condensable gases
- Compact, easy-to-operate analysis unit
- Heated capillary inlet up to 350°C
- Bakeable all-metal sealed high vacuum chamber for low backgrounds
- Maximum sensitivity thanks to closed ion source and field axis technology
- Reliable identification of unknown gases with the help of spectral libraries



Figure 2: Rotary vane pumps from Pfeiffer Vacuum are used by Micromeritics GmbH for sample preparation and physisorption measurements.



Figure 3: DuoLine rotary vane pump and OmniStar gas analyzer from Pfeiffer Vacuum.

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**Pfeiffer Vacuum GmbH**  
Headquarters · Germany  
T +49 6441 802-0

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