

## HiBarSens

**Ultra-high barrier properties are finally measurable**



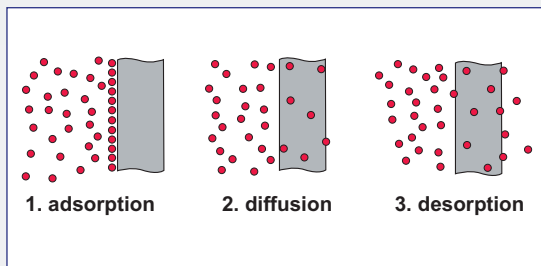
### Task

Beyond mechanical protection, packaging materials for food and pharmaceuticals have another important further function: They have to protect the products against atmospheric gases. Especially water vapor and oxygen are critical features concerning the quality and durability of these products.

Foils with barrier coatings are applied in order to suppress the gas permeation (the gas transport through a solid object). To ensure their long-time stability electronic and optoelectronic components have the highest demands to the barrier effect of encapsulation layers.

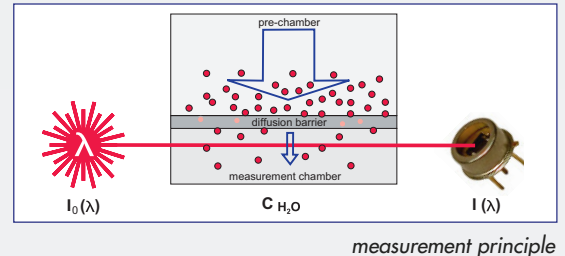


permeation measurement system HBS 18-1

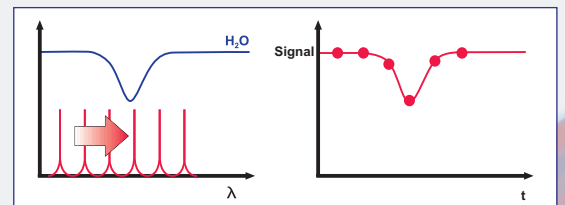


basic principle of permeation

The introduction and application of new technologies like OLED-displays, organic solar cells or vacuum insulation panels require barrier properties which are below the detection limit of today's commercial permeation measurement techniques. A new permeation measurement system using a laser diode spectroscopic sensor has been developed to ensure the detection of ultra barrier material down to water vapor transmission rates (WVTR)  $< 10^{-6} \text{ g[H}_2\text{O]} \text{ m}^{-2} \text{ d}^{-1}$ .



measurement principle



signal generation

### Principle

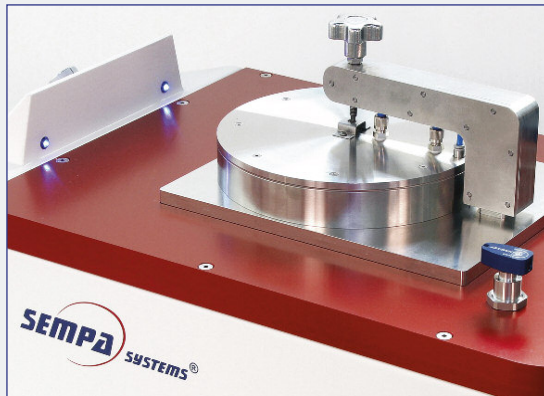
Laser spectroscopic trace gas analysis is the basis of this novel measuring device. Apart from the possibility to reliably detecting gases within the range of ultra traces (ppb) neither a drift of the sensor nor a hysteresis of the sensor appears due to the optical measuring system. Additionally the measurement takes

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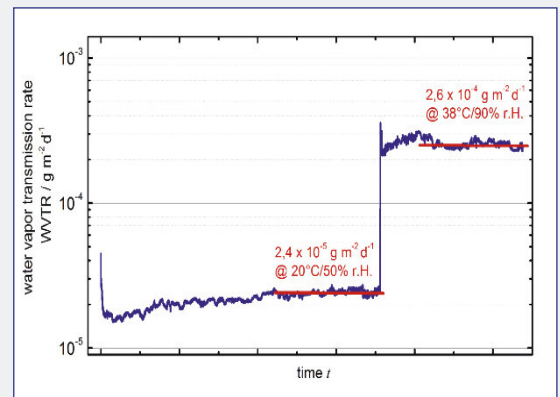
place very close to the barrier foil which avoids a time delay.

During the dynamic measurement mode a continuous pre-dried inert gas flow is led through the permeation cell, that means the steady-state gas concentration is measured. The permeated water vapor significantly determines the moisture equilibrium concentration. Thus the water vapor permeation rate of tested barrier material can be calculated.



permeation cell of HBS 18-1

The diffusion measurement mode enables an increased sensitivity. The permeate transport takes place by diffusion through a capillary. Due to the slow diffusive permeate transport the moisture concentration in the measurement cell increase to a higher and constant level than in dynamic mode and permeation rates in the  $10^{-6}$  g[H<sub>2</sub>O] m<sup>-2</sup> d<sup>-1</sup> level become measurable.



HiBarSens Diffusion Permeation measurement of ultra barrier material

## Results

The water vapor permeation measurement system HiBarSens was design and tested to study the water vapor transmission rate of ultra barrier films. HiBarSens enables the reliable detection of permeation rates down to  $10^{-6}$  g[H<sub>2</sub>O] m<sup>-2</sup> d<sup>-1</sup> by uniquely three measurement modes: dynamic, combination and diffusive.

## Advantages

### Using a Laser Diode Spectroscopic Gas Sensor (LDS)

- › Unsurpassed detection sensitivity
- › Huge dynamic range
- › Highest selectivity
- › Minor sensor maintenance
- › Extrem long-time stability
- › No drift caused of saturation or over drying
- › Permeate detection close to the sample
- › Short permeate transport to the sensor
- › Low potential adsorption surface
- › Measurement under typical application conditions (pressure, temperature, moisture)

### Active sample sealing to suppress ambient humidity level

## Specification

<b>permeate:</b>	H <sub>2</sub> O
<b>measurement range:</b>	Dynamic: $10^{-5}$ – 2 g[H <sub>2</sub> O]m <sup>-2</sup> d <sup>-1</sup> Combination and diffusion: $10^{-6}$ – $10^{-2}$ g[H <sub>2</sub> O]m <sup>-2</sup> d <sup>-1</sup>
<b>sensor:</b>	Laser Diode Spectroscopic Gas Sensor
<b>temperature range:</b>	10 °C to 50 °C ± 0,05 °C
<b>rel. humidity range:</b>	60 % to 95 % r.H. ± 2 % 100% r.H.
<b>sample size:</b>	Ø 200 mm
<b>sample thickness:</b>	20 µm to 5 mm
<b>dimension:</b>	550 x 350 x 380 mm
<b>weight:</b>	approx. 35 kg
<b>power supply:</b>	100-230 V AC 50-60 Hz