# miniHUM

## a miniaturized device to measure trace-humidity on mars

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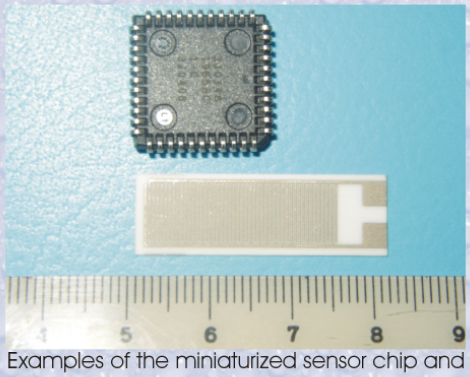
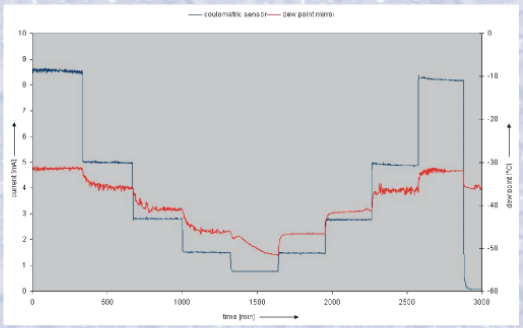
light temperature pressure humidity

Humidity can be measured by a variety of methods, among them capacitive polymer sensors and dew-point mirror temperature measurements. The coulometric method is used for many applications in industrial process monitoring of trace gases. Because the cell functions best for trace contents of water vapor and is more sensitive than capacitive sensors or the standard dew-point mirror method under low-temperature conditions (< - 60° C) it is particularly appropriate for applications under martian conditions.

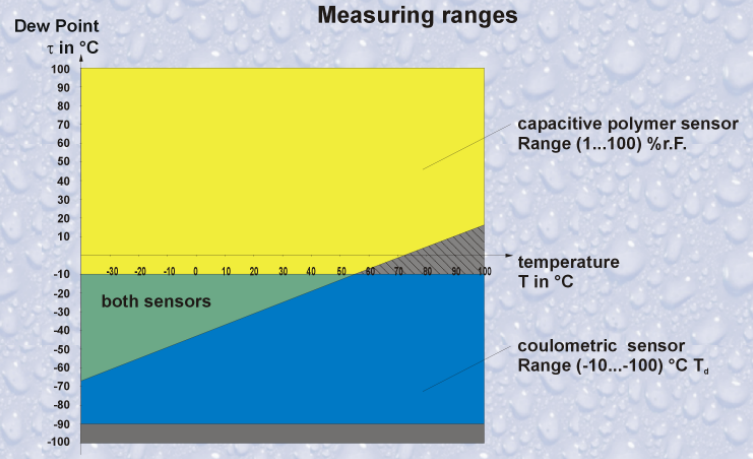


Examples of the miniaturized sensor chip and miniaturized electronics (above). The thickness of the chip is 0.5 mm. The array can be on one or on both sides of the chip. The size can be adapted according to requirements.



Comparison of the miniaturized coulometric cell with the standard dew-point mirror method. The right axis describes the dew point temperature (in °C), and the left axis gives the electric current (in mA) measured at the coulometric cell. The coulometric cell signal (blue line) quickly follows predetermined changes in humidity that are monitored in the experiment chamber by the dew-point mirror (red curve).

The dew-point mirror method is often used as a standard method. The superiority of the miniaturized coulometric cell, as it is used for miniHUM, with respect to the dew-point standard is shown below. The sensor chip can be shaped and miniaturized, according to experiment requirements. The left figure gives an example.




Measurement range for a combinated sensor coulometric cell for trace humidity capacative cell for middle and high humidity

miniHUM is robust and with a complete mass of clearly less than 10 g most appropriate to be used in martian in-situ experiments. Corresponding applications have been sent to NASA and ESA.

| Technical Data | | |
|---|---|---|
| Measurement principle | | Coulometric cell |
| Range | Dew-point temperatures $T_d$ [°C] | - 100... - 20 or |
| | Parts per million | (0...1000)ppmv |
| Working range (environmental temperatures [°C]) | | < - 90...+ 60 |
| Sensor signal output [µA] | | 0,0001...10.000 |
| Specifications | | self-checking sensor, automatic zeropoint measuring, works in aggressive media |
| Requirements/properties | | |
| HUM-Data requirements | | according to requirements, 1 min |
| Mass [g] | Humidity sensor | 1 g |
| | miniHUM-Electronics | 5 g |
| Power per HUM-measurement | | 12 VDC ; |
| Dimensions [mm] | | |
| | HUM-sensor | < 30 x 10 x 0.3 |
| | HUM-electronics | < 15 x 15 x 0.5 |


**Dr. Wernecke & Partner**
Technische Beratung, Vertrieb

*supplies the dlr with industrial know-how and own-developed device solutions as used as key role devices within this loboratory*

www.dr-wernecke.de
www.humilab.dr-wernecke.de

# Moisture & Humidity

## The Mars-Simulation-Facility at DLR-Berlin

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light


temperature


pressure


humidity

controlling the main environmental influences is a key role in martian simulation

## introduction

The atmospheres of planets can be simulated at HUMILAB with respect to humidity, pressure, gas composition, insolation (VIS, UV), and in the diurnal variation of these (and if required, other) planet- and Mars-relevant parameters. This complex experiment set is of a modular structure, and it can be adapted to specific and extreme conditions.

**Examples of applications of Mars-Simulations:**

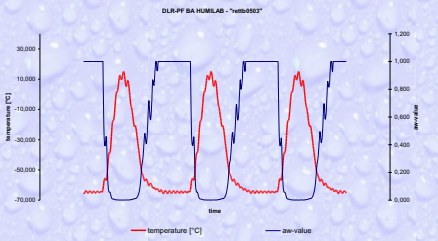
**-sorption isotherms of relevant soil minerals**
**-water activity determinations**
**-water bearing capacity of relevant soil minerals**
**-mechanical properties, chemical processes**
**-long-term survival of organisms under martian conditions**

HUMILAB CLIMATE SIMULATION LABORATORY


sample container (top)

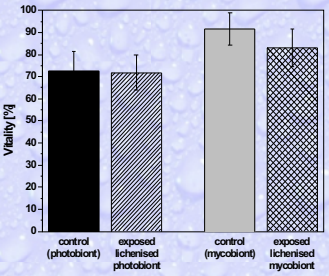

open sample container


sample container within freezing chamber



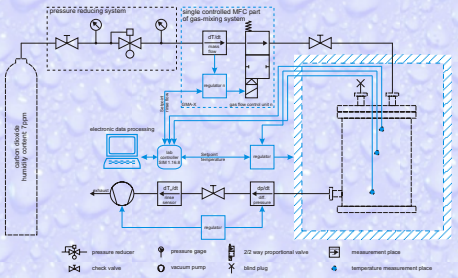
diurnal variation of temperature and humidity on mars

## Example: martian atmosphere



Biology experiment (survival of lichen) with Universität Düsseldorf et al.


specimen holder



lab schematic for simple biological purposes

## Technical Solution


gas mixing system in biological mission


(Pre-) Air Dryer section

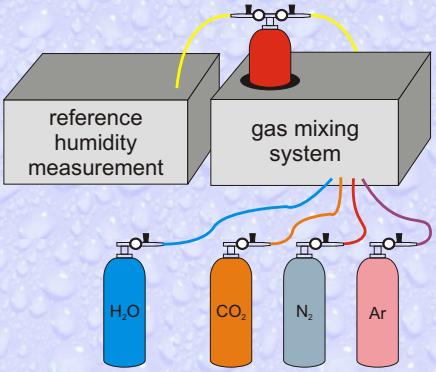
Before we go to mars, we have to know what happens on earth. Thats why we also use free air as a cheap crude material. But as the earth is called the blue planet, the environmental air is too wet. Therefore we need to dry them down by using phyiscal, chemical or other established drying principles.

*every gas component is plugable, and nearly every is possible !*


major data acquisition

We also have enough capabilites to plug high performance industrial sensors via different interfaces and protocolls through our special developed data acquistion hard- and software directly to the internet. So every Customer or person inside the network can directly look into our laboratory (with user specified accessing capaibilites) and take part just in time with the currently running experiment.

*use your own established measurement hardware !*




Our special developed gas mixing system allows us to stick the environmental gas components together like in a construction kit. There are capabilities to plug five gas components together. We not only produce the percentage parts of the components, we also regulate the humidity content down to several ppm. So we have the exact environment with defined humidity as an important simulation parameter. Three outputs are available with flow rates between 50 and a half liter per hour. Controlling this device is simply done with special software via PC.

faith question: Is my gas deliverer free from water ?

**Controlling humidity is a key-task in view of physical, chemical, biological, and other lab-simulations!**