

# RPM – Remote Pressure Monitoring

## Basic requirements

During a microwave decomposition pressure is generated inside the digestion vessels which is made up of the vapour pressure of the acid mixture at the working temperature and the partial pressure of the gases generated by chemical reactions ( $\text{CO}_2$ ,  $\text{NO}_x$  etc).

It is advisable to monitor the pressure at least for method development and critical samples to prevent excess pressure. This is particularly important for organic sample materials because the carbon contained is oxidized to  $\text{CO}_2$  and adds to the total pressure.

Spontaneous exothermic reactions can also be recognized by a rapid pressure increase. In such cases the pressure reading is used to control the microwave power in order to prevent the pressure from rising too high. Pressure control, thus, significantly increases the operational safety.

Additionally, conditions in a microwave system require special properties. The measurement technology must be resistant to the reagents used, usually mineral acids.

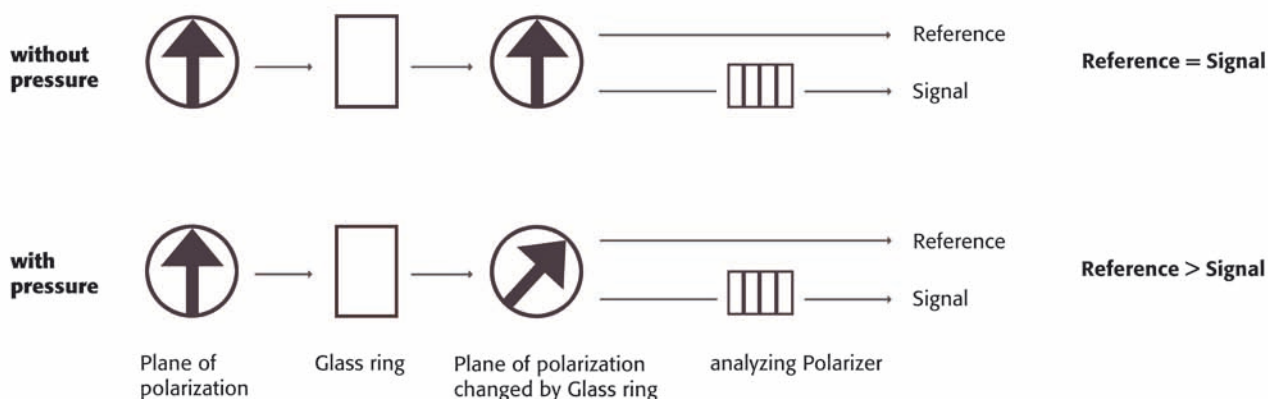
The handling of the vessels should not become complicated by the sensor assembly to prevent leakage or damage by handling errors and to avoid the resulting safety risks and costs.

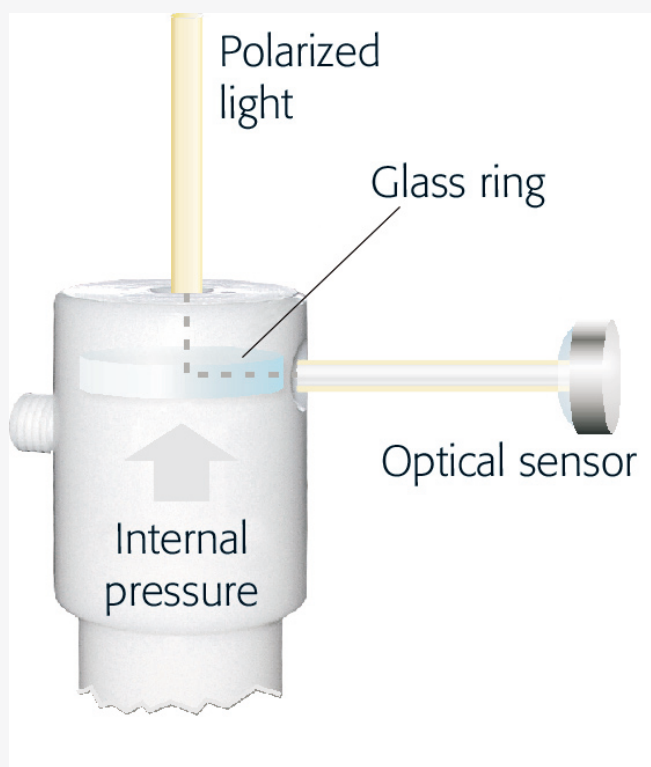
The commonly used mechanical sensor assemblies do not fulfil these requirements. Pressure is often only monitored in one reference vessel.

Even similar samples can behave completely different, though, making monitoring of all samples necessary. Mechanical sensors are likely to be corroded or damaged, and their cable connections make vessel handling more difficult.

## Advantages

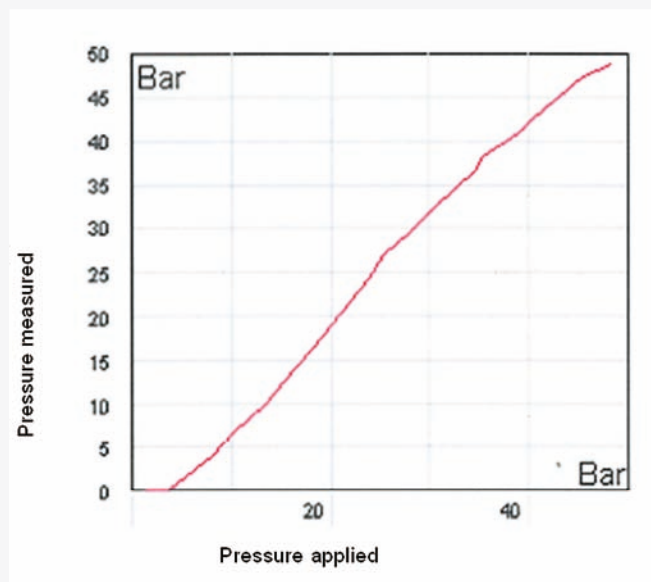
- Direct measurement of all sample temperatures in real time per rotation (ca. 10 sec interval). For method development a single vessel can be positioned in front of the Sensor (interval < 1 sec.)
- No sensor inside oven, no difficult assembly
- Highest chemical resistance
- No damage by frequent connection/ disconnection of sensors
- No cable connections
- Electronic parts are located outside microwave field





▲ Measurement principle RPM

▼ RPM cap is tested and certified



## Analytik Jena Remote Pressure Monitoring (RPM)

The optical pressure measuring technique RPM guarantees operational safety and easy handling by its innovative measuring principle.

The contactless sensor system offers flexibility and comfortable operation. Any number of reaction vessels can be equipped and individually be monitored with RPM because the sensor element is integrated in the screw cap of the vessels. RPM is the only technology that allows an individual pressure display for every single vessel. One, some or all vessels can be equipped with RPM.

Because of its simple assembly it is robust, almost wear free and thus cost saving.

RPM screw caps are used just like the ones without RPM, no tools or special procedures are required.

## Functionality

The actual sensor element consists of a glass ring integrated in the screw cap of the digestion vessel. The glass ring is irradiated with polarized light and changes its polarization behaviour under pressure. This change is measured and used to calculate the pressure inside the vessel.

The physical principle on which the measurement technology is based is the birefringence of glass under mechanical stress (shear, bend, pressure). Trivially said, glass changes the plane of polarization when put under mechanical stress. The more pressure is applied, the more the polarization plane will be rotated.

By irradiating the glass with polarized light and analyzing the light with a second polarizer, the degree of rotation can be detected by a decreased light intensity. The incident light intensity is normalized by a reference detector.

The correct behaviour of each RPM cap is tested and certified by the factory. The sensor in the instrument is factory-calibrated, too.

At the beginning of a microwave run, the pressure is automatically set to zero, so the initial force with which the vessel is closed does not influence the pressure reading. This makes tools for reproducible closing of the vessels (e.g. torque wrench) unnecessary.

The measuring electronics are located outside the oven cavity, there are no cables inside the oven because an optical principle is used. This way the electronics are protected from microwave radiation and corrosive acid fumes.