Sorptionsgleichgewichte von Gasen in schwellenden Sorbentien Oszillometrisch-gravimetrische und oszillometrisch-manometrische Messungen

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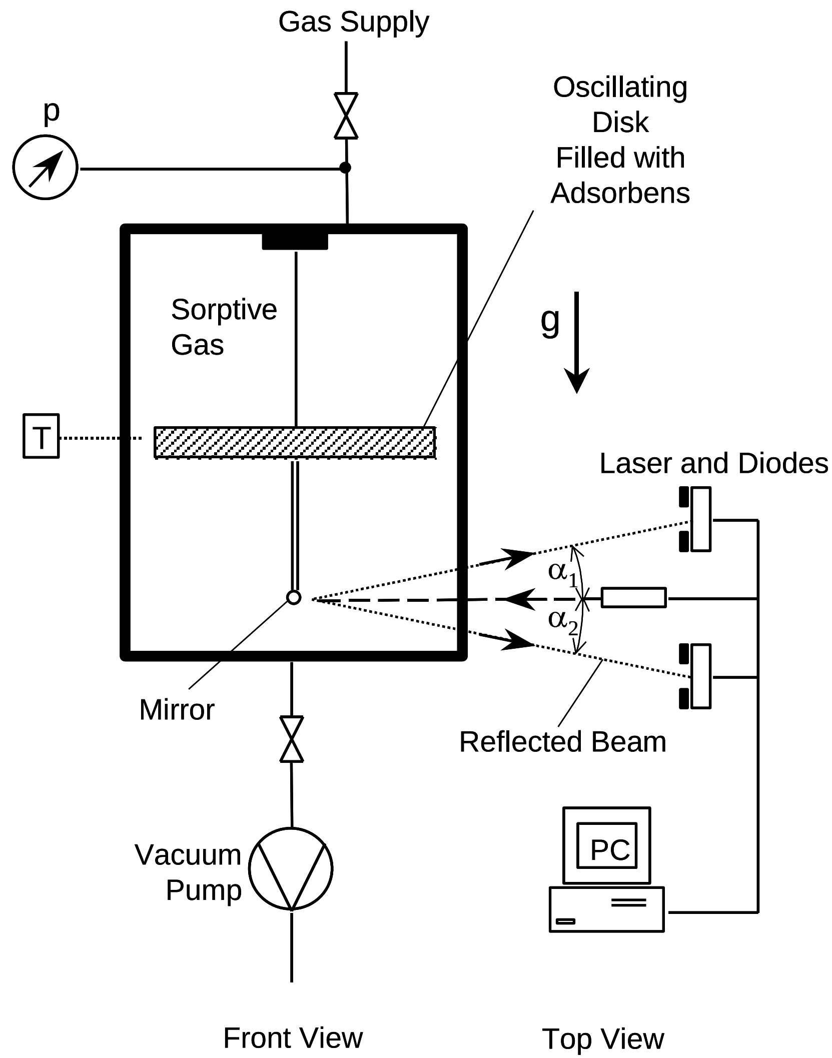
1. Oszillometrie
2. Versuchsanlage
3. Theorie
4. Testmessungen
5. Polymermessungen
6. Danksagung (DFG, BASF)

Literatur

Rave H.
Messung von Sorptionsgleichgewichten von Gasen an Feststoffen mit Hilfe langsamer Schwingungen eines Rotationspendels, Fortschritt-Berichte VDI, Reihe 3, Verfahrenstechnik, Nr. 660, VDI-Verlag, Düsseldorf, 2000.

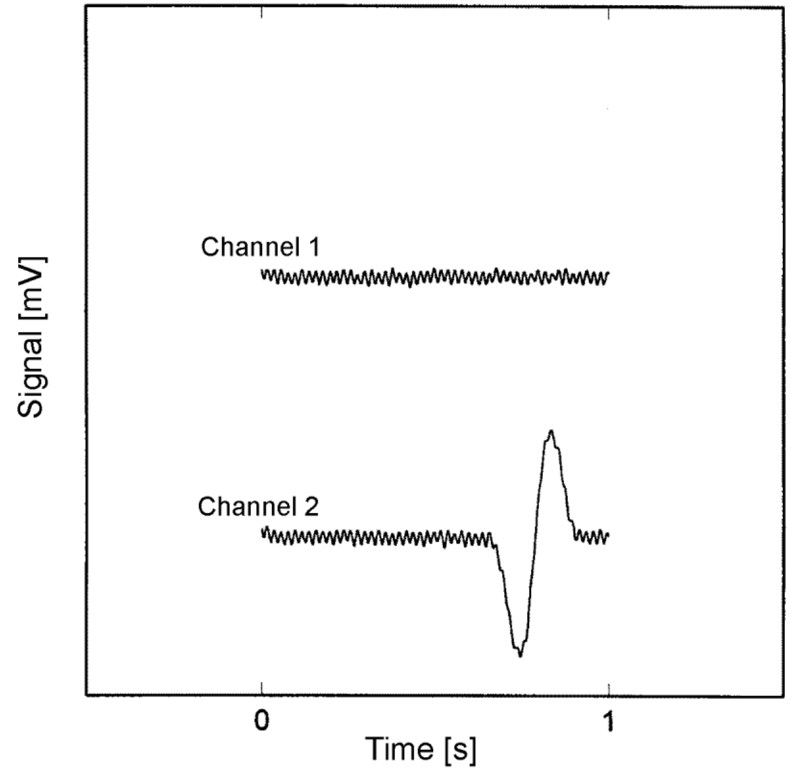
Keller J.U., Rave H., Staudt R.
Measurement of Gas Adsorption in a Swelling Polymeric Material by a Combined Gravimetric-Dynamic Method, Macromol. Chem. Phys., 200 (1999), 2269-2275.

Keller J.U., Staudt R.
Gas Adsorption Equilibria, Experimental Methods and Adsorption Isotherms, Kluwer, Dordrecht etc., 2004.



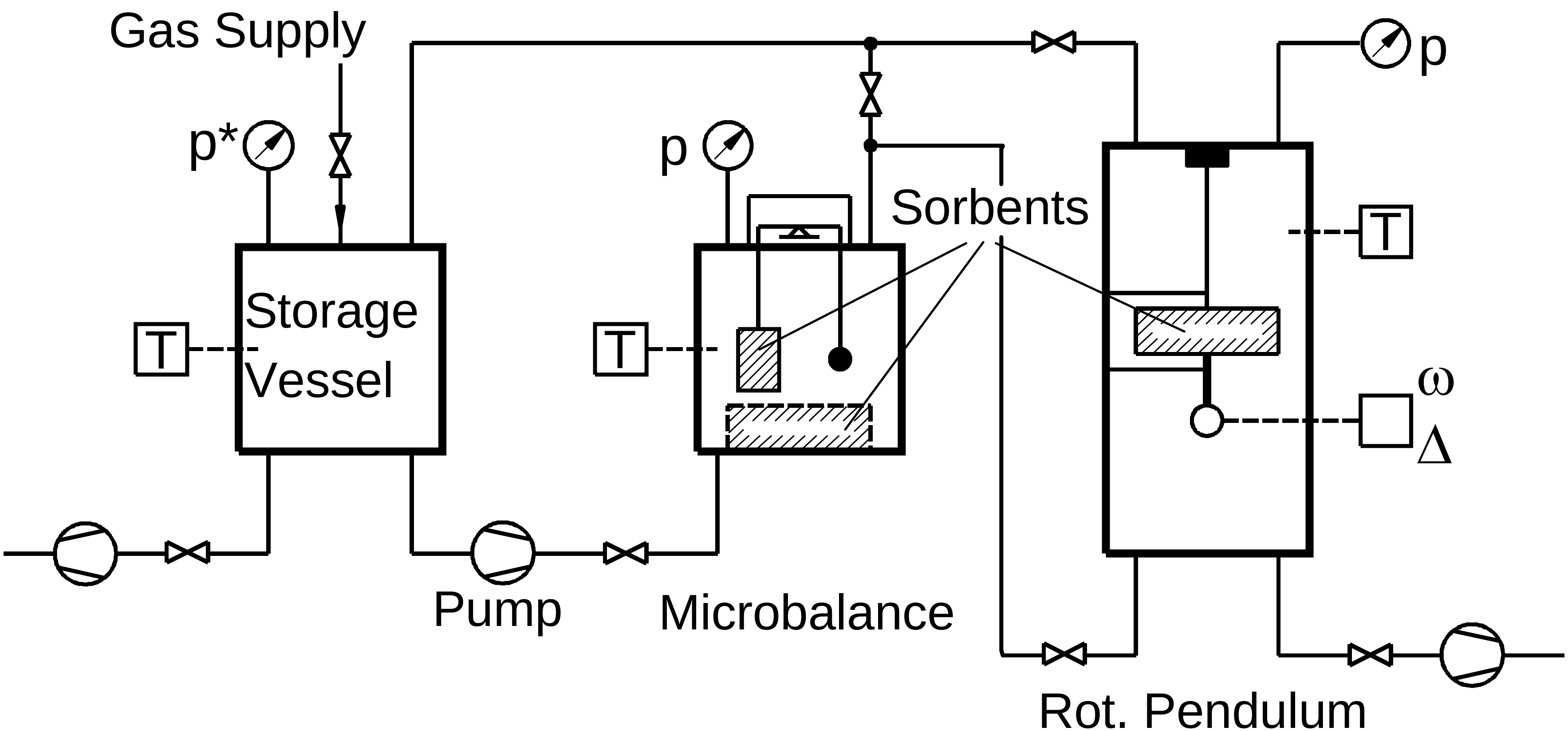
Rotational pendulum for measurements of gas adsorption equilibria by observing slow damped oscillations. Height of instrument: 1.5 m.

Experimental Setup for oscillometric measurements of gas adsorption equilibria using a rotational pendulum.

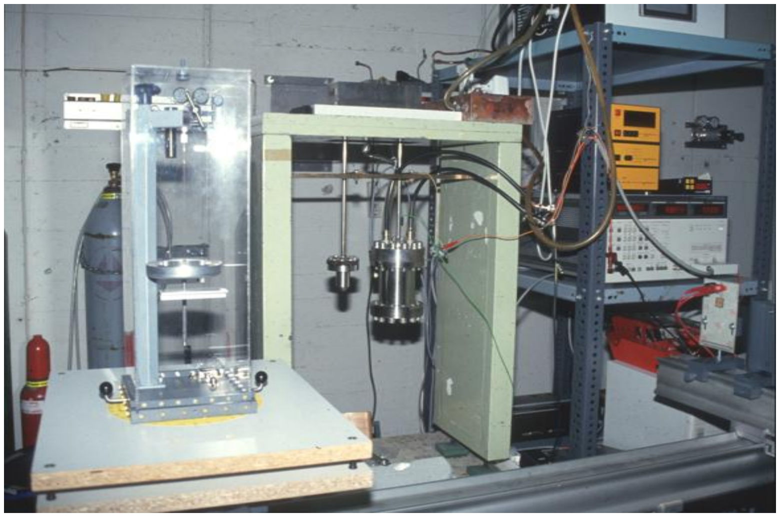


Rotational Pendulum for combined oscillometric-gravimetric sorption measurements of gases in swelling (polymeric) materials.

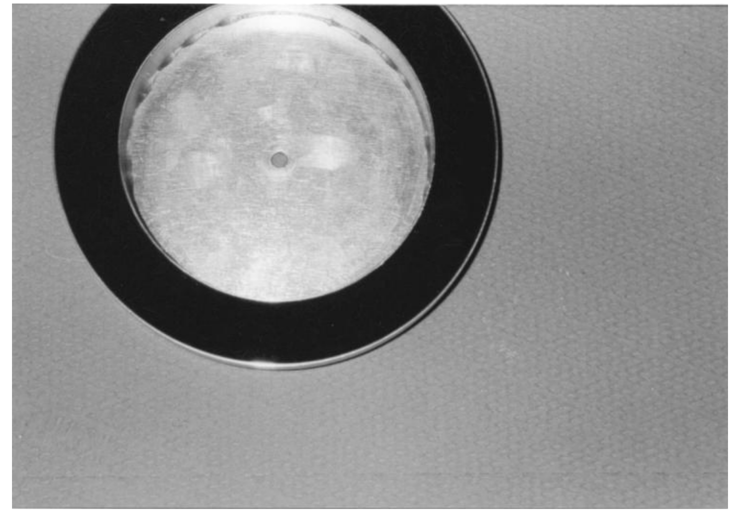
Electric signals of the photodiodes initiated by the reflected laser beam crossing diode channel 2.



Scheme of an instrument for manometric-gravimetric-oscillometric measurements of binary coadsorption equilibria in swelling materials (polymers, resins etc.) without sorptive gas analysis by GC or MS.

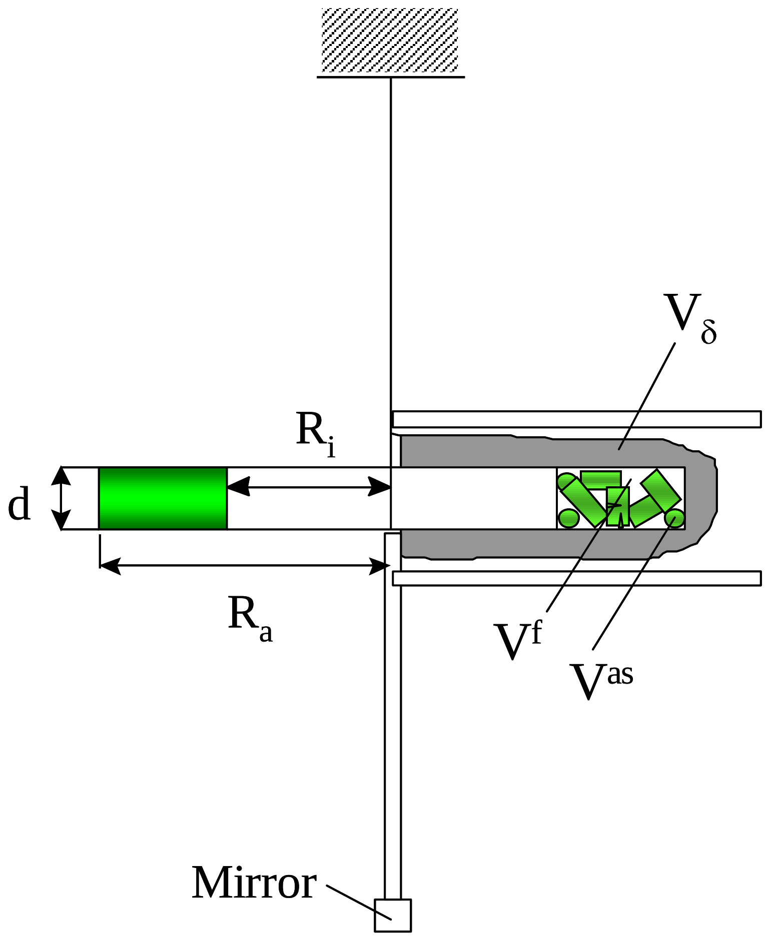


Training instrument for
oscillometric,
volumetric,
gravimetric and
dielectric
gas adsorption measurements .



Ring-slit of pendulum (R_i=3.75cm, R_a=5.5cm) filled with activated carbon powder (Norit R1 Extra).

Theory



$$p : V^{f}, V^{as}$$

$$p = 0 : V_0^{f}, V^{s}$$

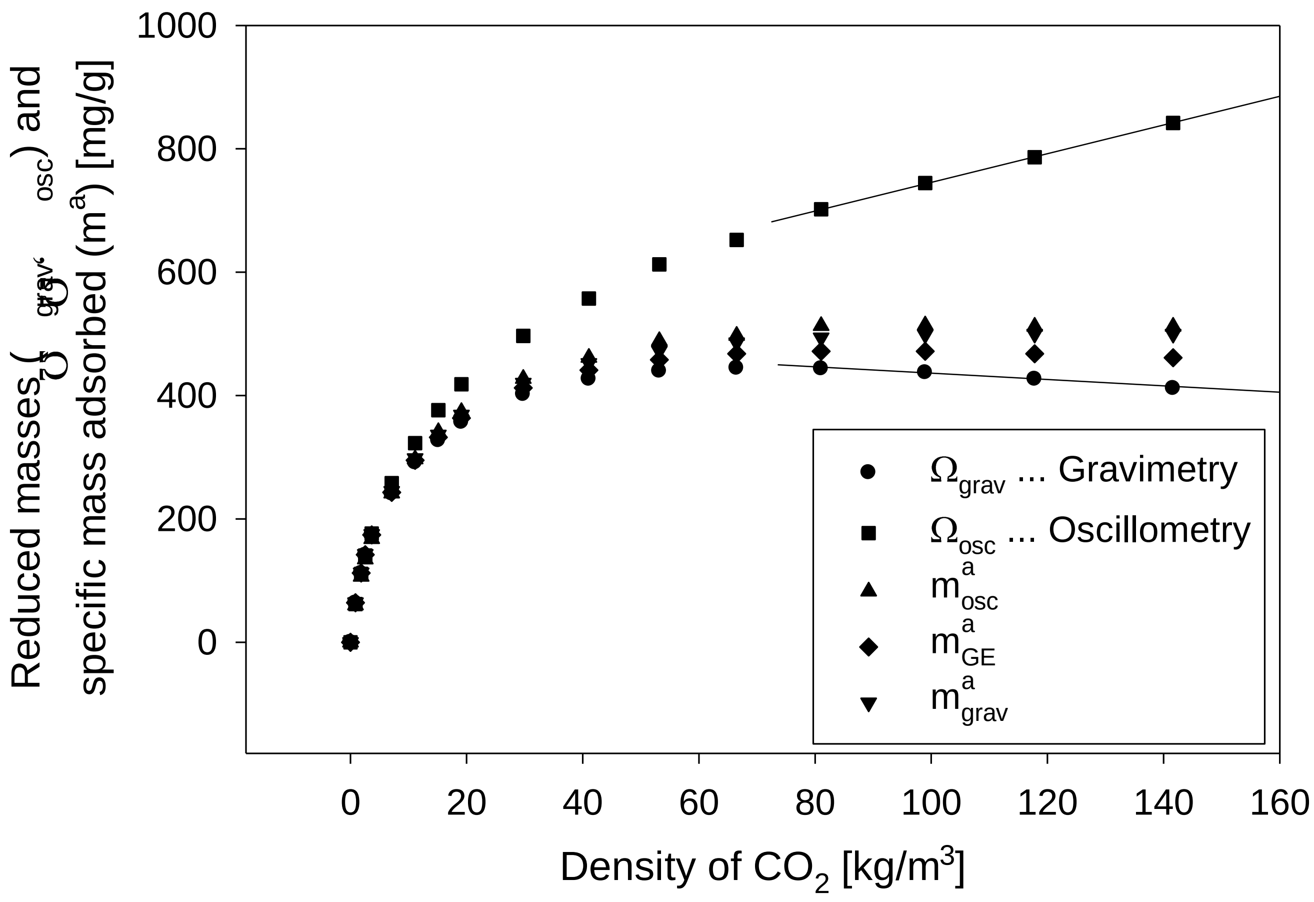
$$(1)\quad V^{f} + V^{as} = \frac{1}{\rho^{f}}\ \Omega_{osc} + \Omega_{gra} \ - V_{\delta}$$

$$(2)\qquad \frac{V^{s}}{V^{f}} = \frac{V}{V_0^{f}} = \frac{1}{b(t)}$$

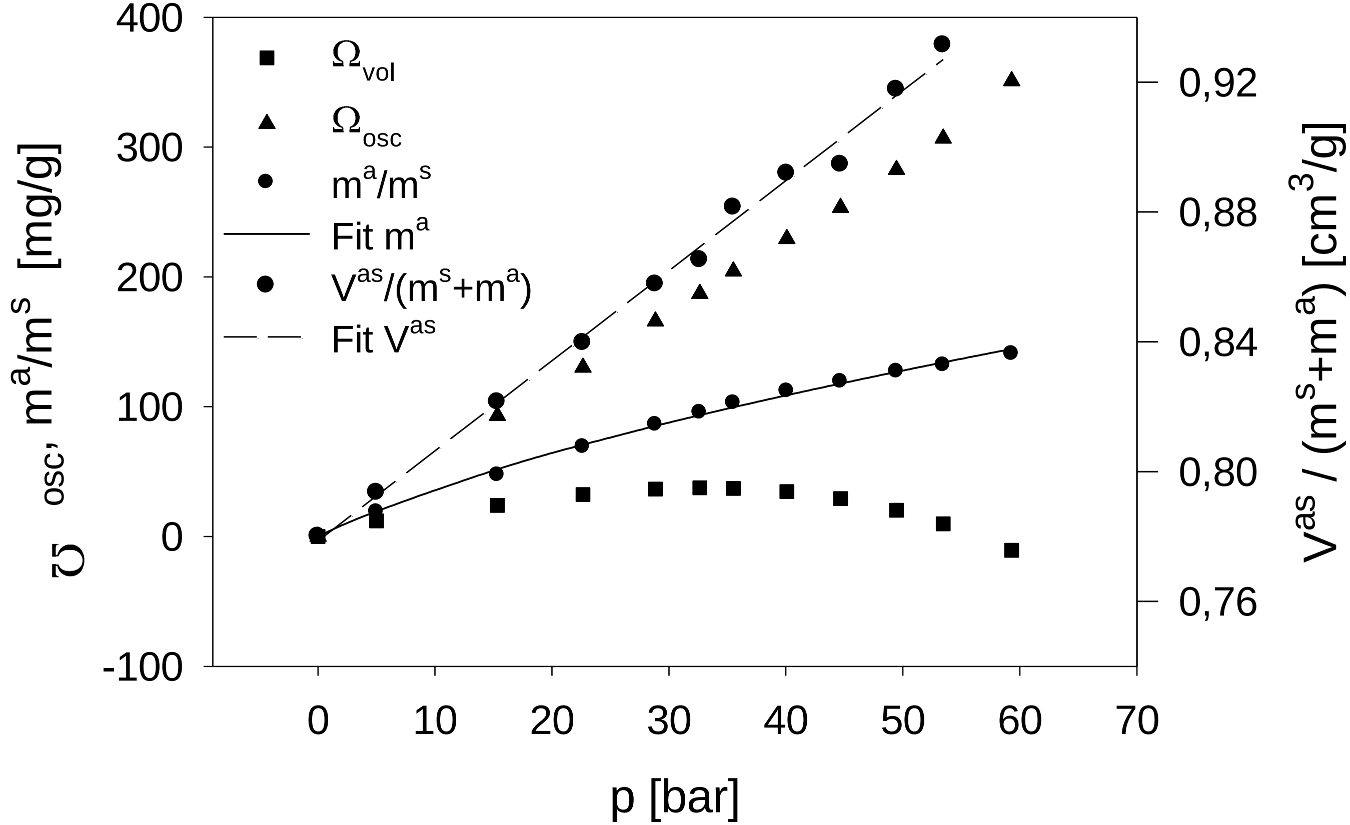
V_{δ} ...non – sorbing pellets

$$\Omega_{gra} = m - \rho^{f} V^{s} \rightarrow m$$

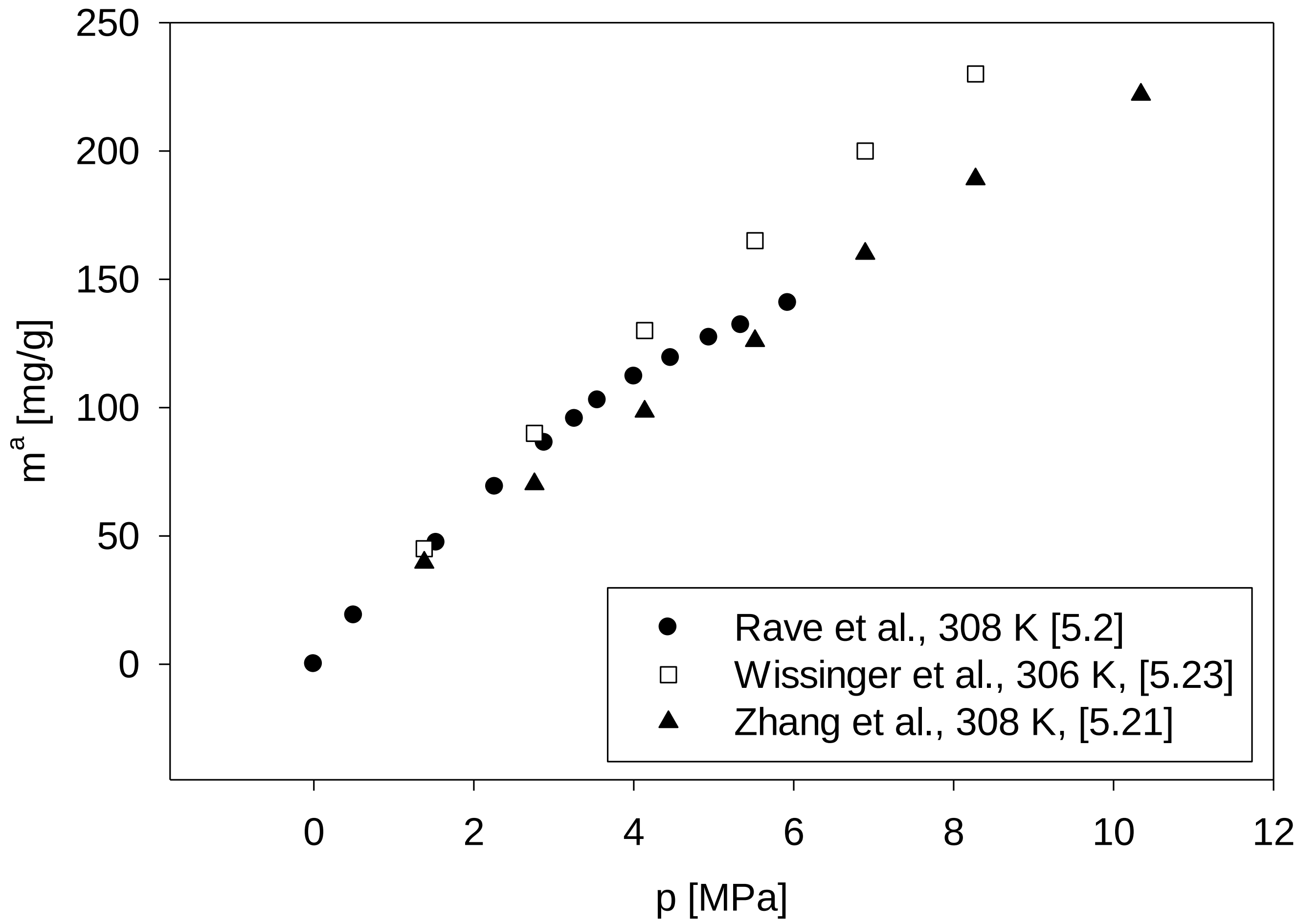
$$\frac{\Omega_{osc}}{m^{s}} = \frac{\dfrac{1}{J_0} - 1}{1 - \dfrac{J^{*}}{J_0}} = \frac{\dfrac{1+\Delta_0^2}{1+\Delta_E^2}\left(\dfrac{\omega_0}{\omega_E}\right)^2 - 1}{1 - \dfrac{\Delta_0 \omega_0}{\Delta^{*} \omega^{*}}}$$



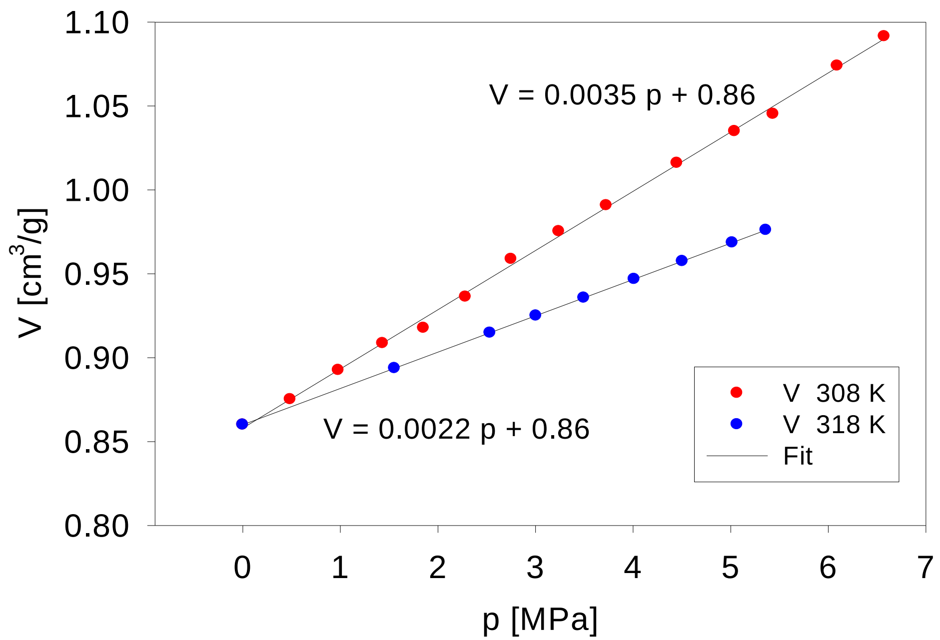
Reduced masses resulting from oscillometric and gravimetric adsorption measurements (Ω_{osc}, Ω_{grav}) of CO_2 on activated carbon (Norit R1 Extra) at 293 K. Gibbs excess masses (m^a_{GE}) and absolute masses adsorbed (m^a_{osc} ,m^a_{grav} -data).



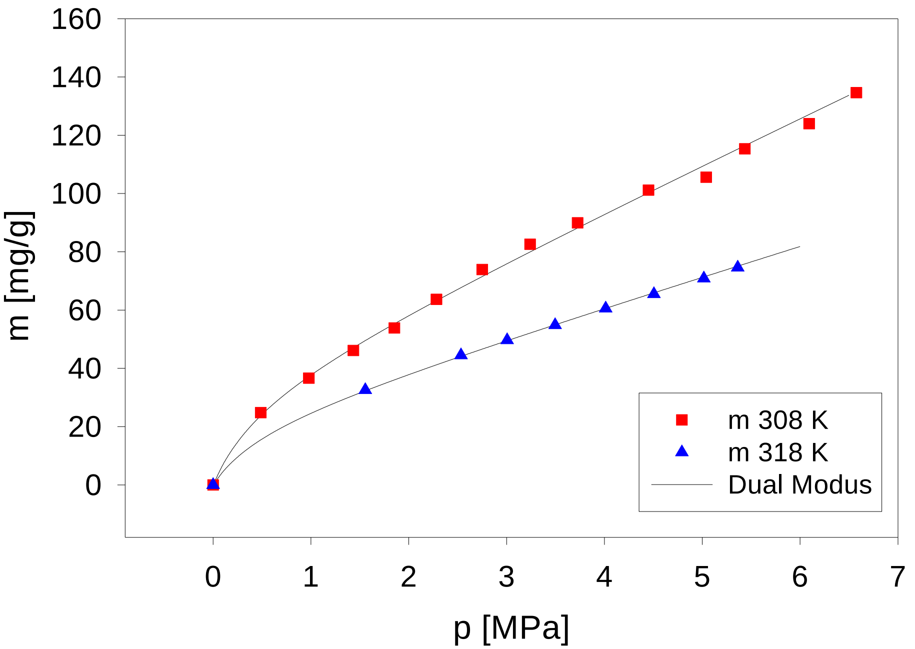
Swelling of volume (V^{as}) and sorption isotherm (m_a) of CO_2 on polymethylmethacrylate Makrolon 2400 (PMMA, Bayer) at 308 K.



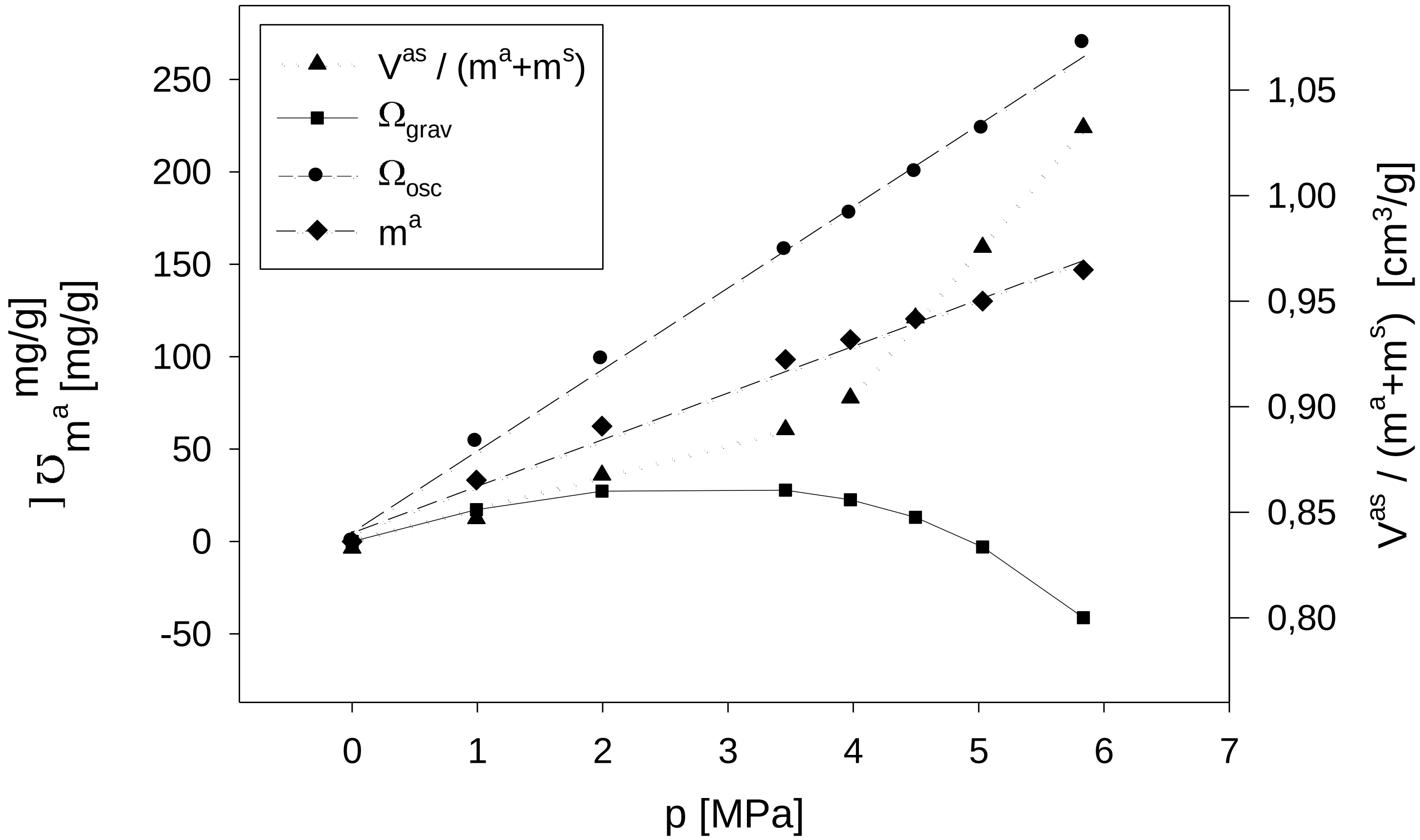
Comparison of swelling isotherms for the system Makrolon 2400 (PMMA)/CO_2 at about 308 K.



Swelling isotherms of polycarbonate/CO_2 at T = 308 K and T = 318 K.



Sorption isotherms of polycarbonate/CO_2 at T = 308 K and T = 318 K.



Swelling and sorption isotherm of polycarbonate/CO_2 at 293 K.