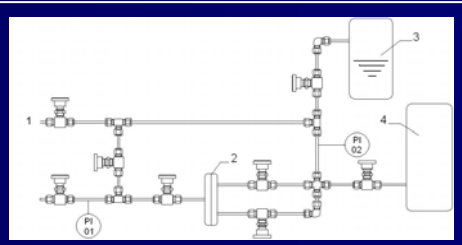
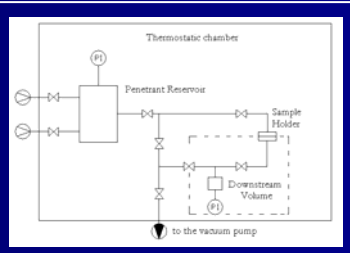
Equipment

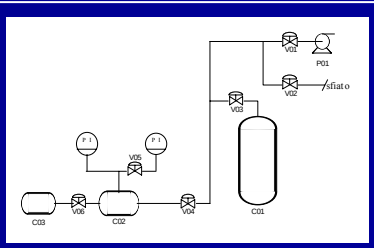
Medium to high pressure equipment



Permeometer at controlled humidity

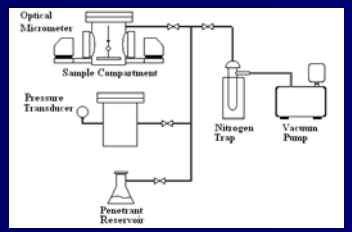


Permeometer (2)



Pressure decay
1.Low pressure Vapor Sorption

2.High pressure Gas Sorption
(< 30 bar)



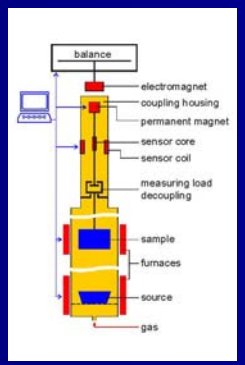
Dilatometer

Optical device

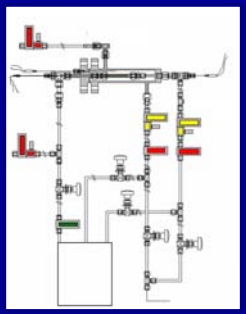
Membranes

High pressure High temperature Gas Sorption in polymers and inorganic powders

Magnetic Suspension Balance Rubotherm



High pressure High temperature Mixed gas permeation apparatus for hydrogen purification studies (inorganic membranes)



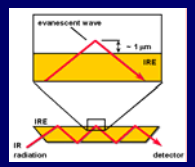
Equipment

Low to medium pressure equipment

Vapor and liquid Sorption and diffusion

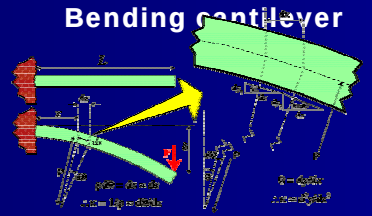
castable films

FTIR-ATR



Vapor Sorption and stress measurement

Bending cantilever

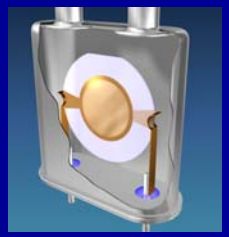


Vapor Sorption

Soluble materials

(thin films)

Quartz Crystal Microbalance

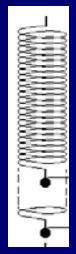


Vapor Sorption

Soluble materials

Low pressure

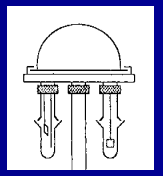
Quartz Spring



Vapor Sorption

Soluble materials

Electro Microbalance



Equipment

- Experimental equipment:
  - **Cahn Electrobalance**
  - Pressure Decay apparatus (2)
  - Dry Permeometer (2)
  - Humid permeometer
  - Quartz spring balances (2)
  - FTIR-ATR sorption apparatus
  - Bending Cantilever apparatus
  - Quartz Crystal Microbalance
  - Dilatometer
  - Rubotherm Magnetic Balance
  - Hydrogen permeation device
  - Parr Rheometer
  - Spin coater

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  - Cahn Electrobalance
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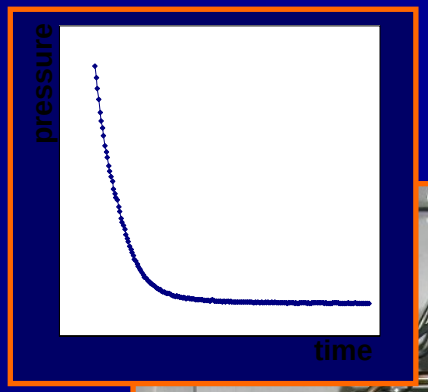
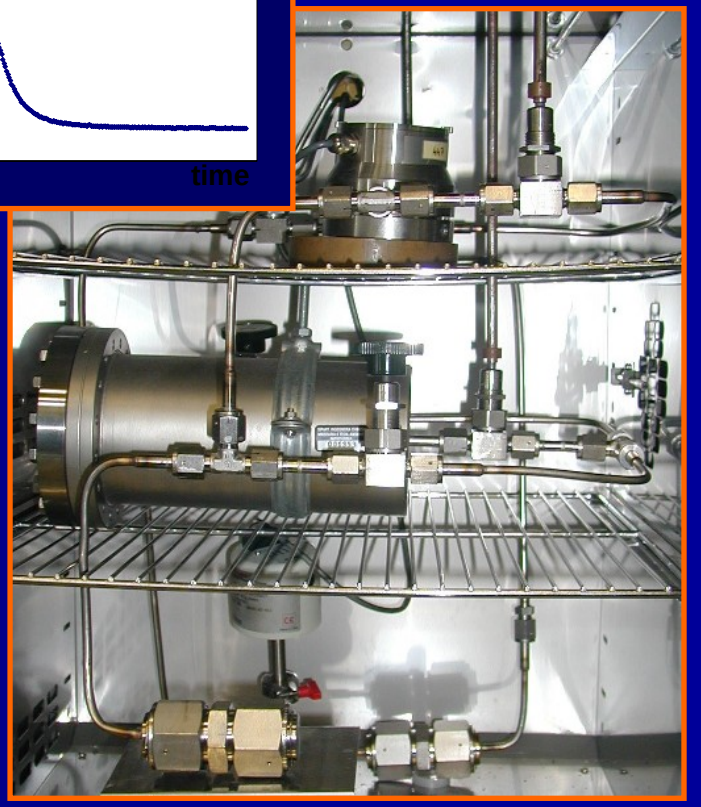


Low pressure
(< 1atm)



Equipment

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  - Dilatometer
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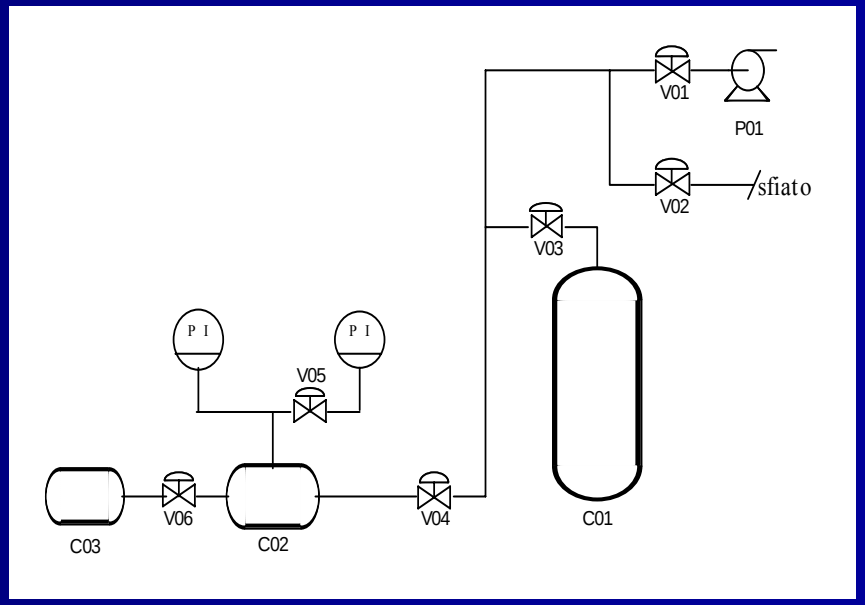
  - Spin coater

High pressure (< 30 atm)



Equipment

- Experimental equipment:
  - Cahn Electrobalance
  - Pressure Decay apparatuses (2)
  - **Dry Permeometer** (2)
  - Humid permeometer
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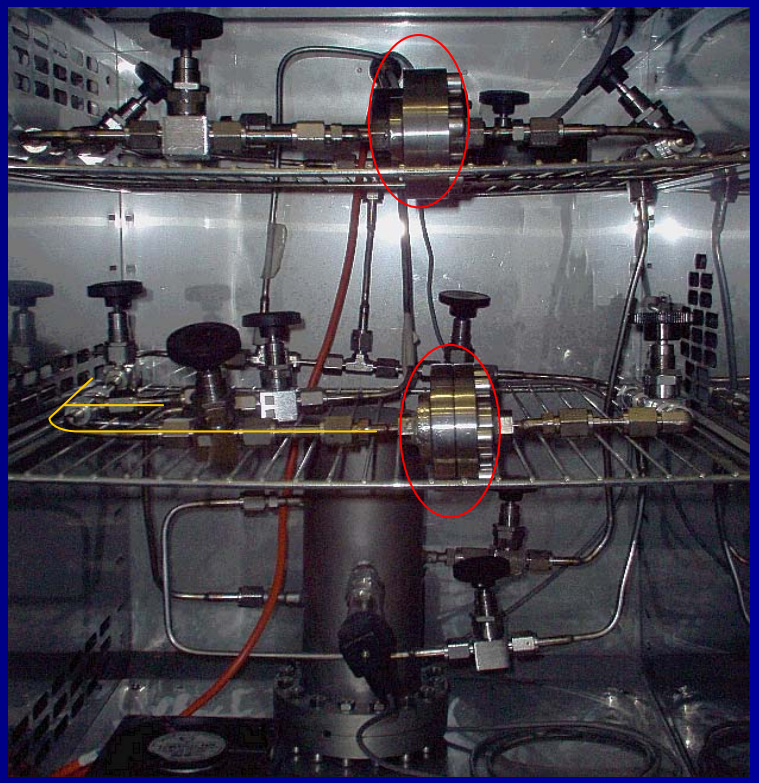
High Delta p (< 30 atm)



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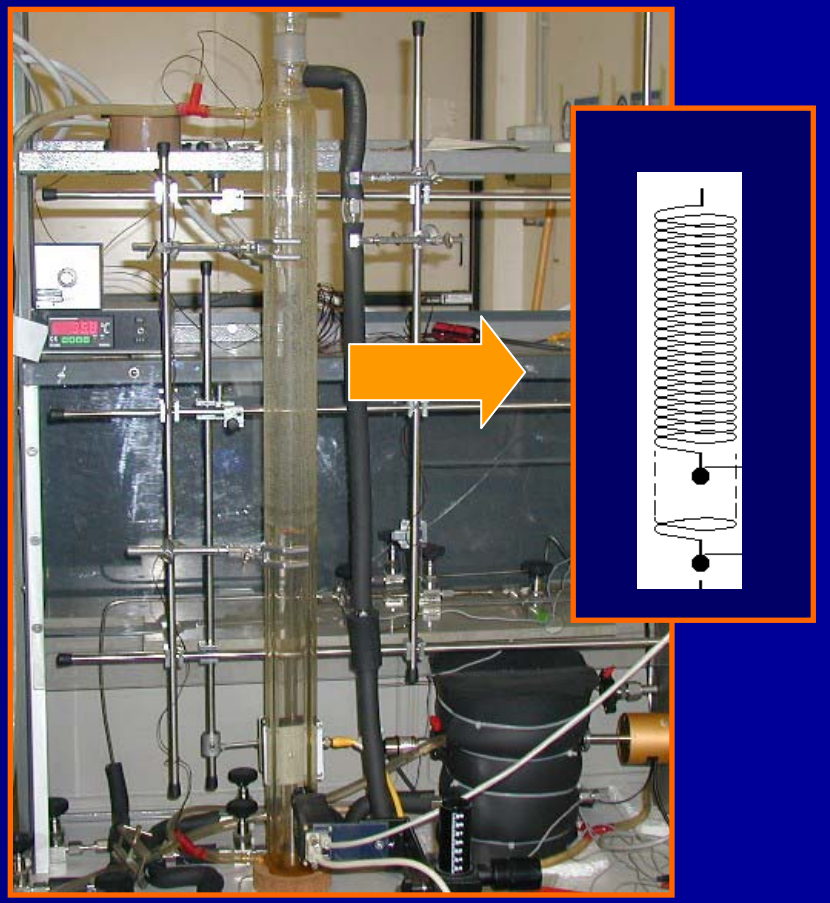

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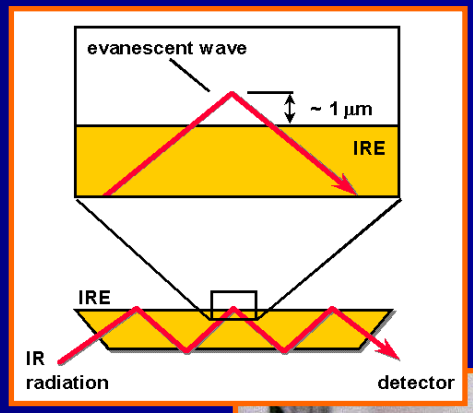

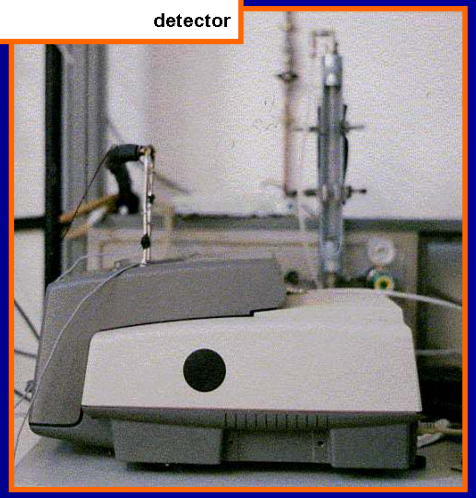

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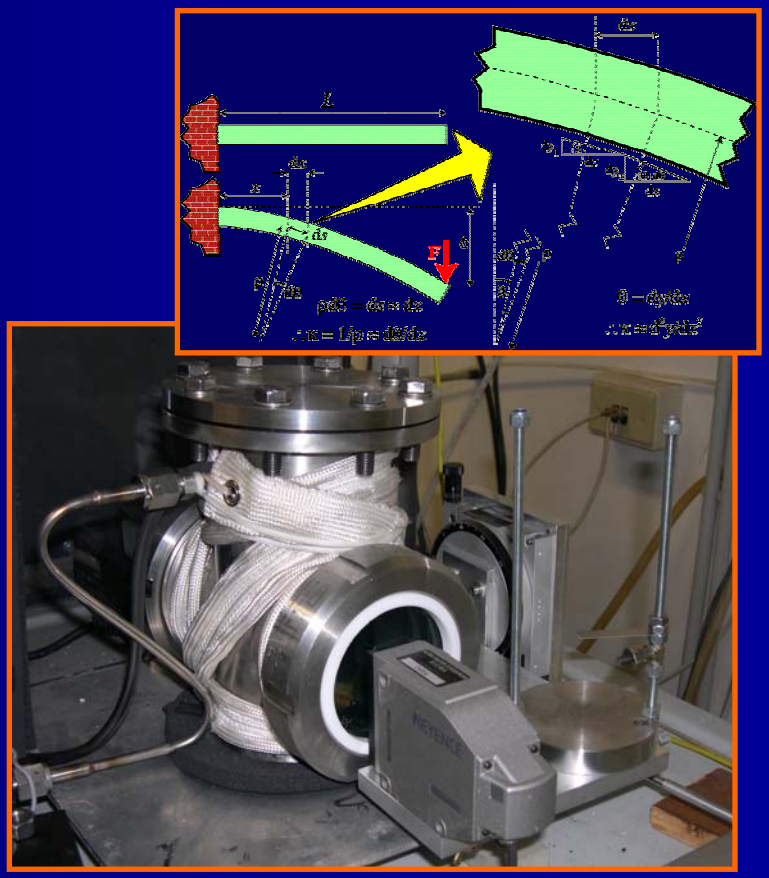

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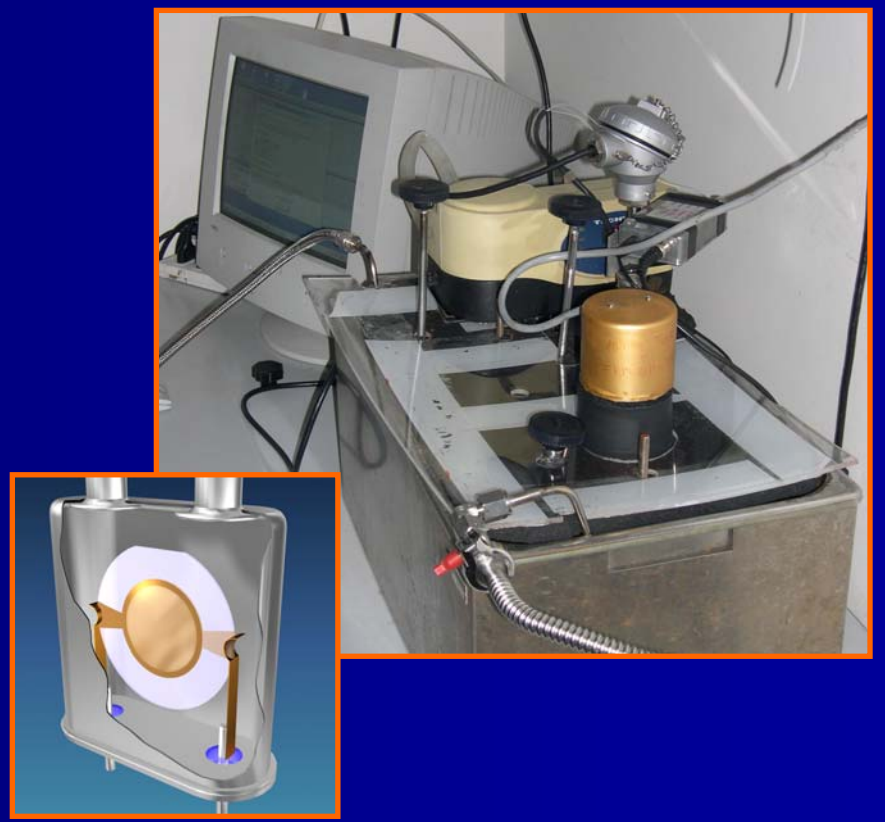
  - Spin coater



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  - **Dilatometer**
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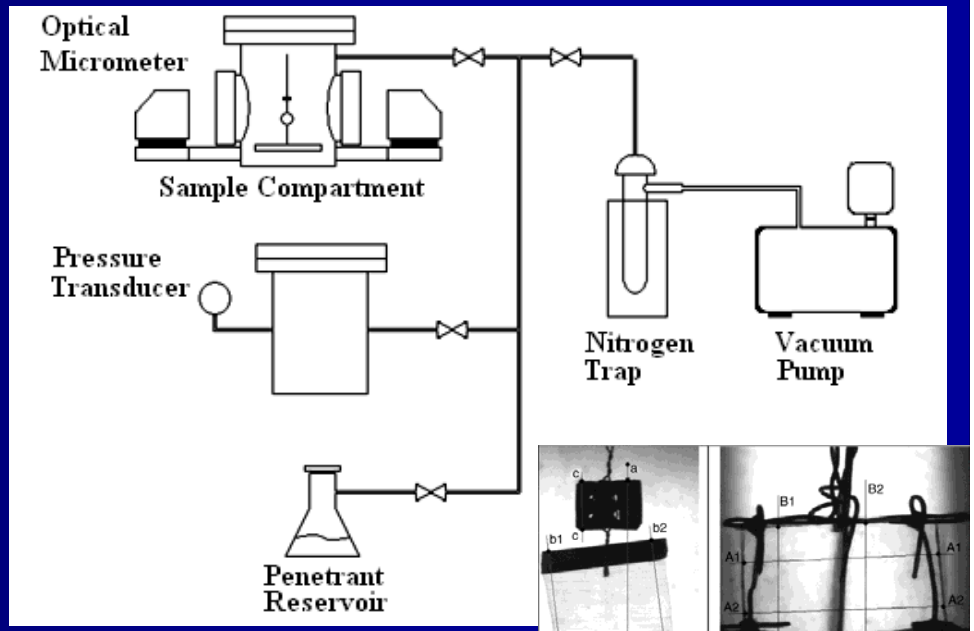
  - Parr Rheometer
  - Spin coater

Determines the swelling induced by gas and vapor sorption



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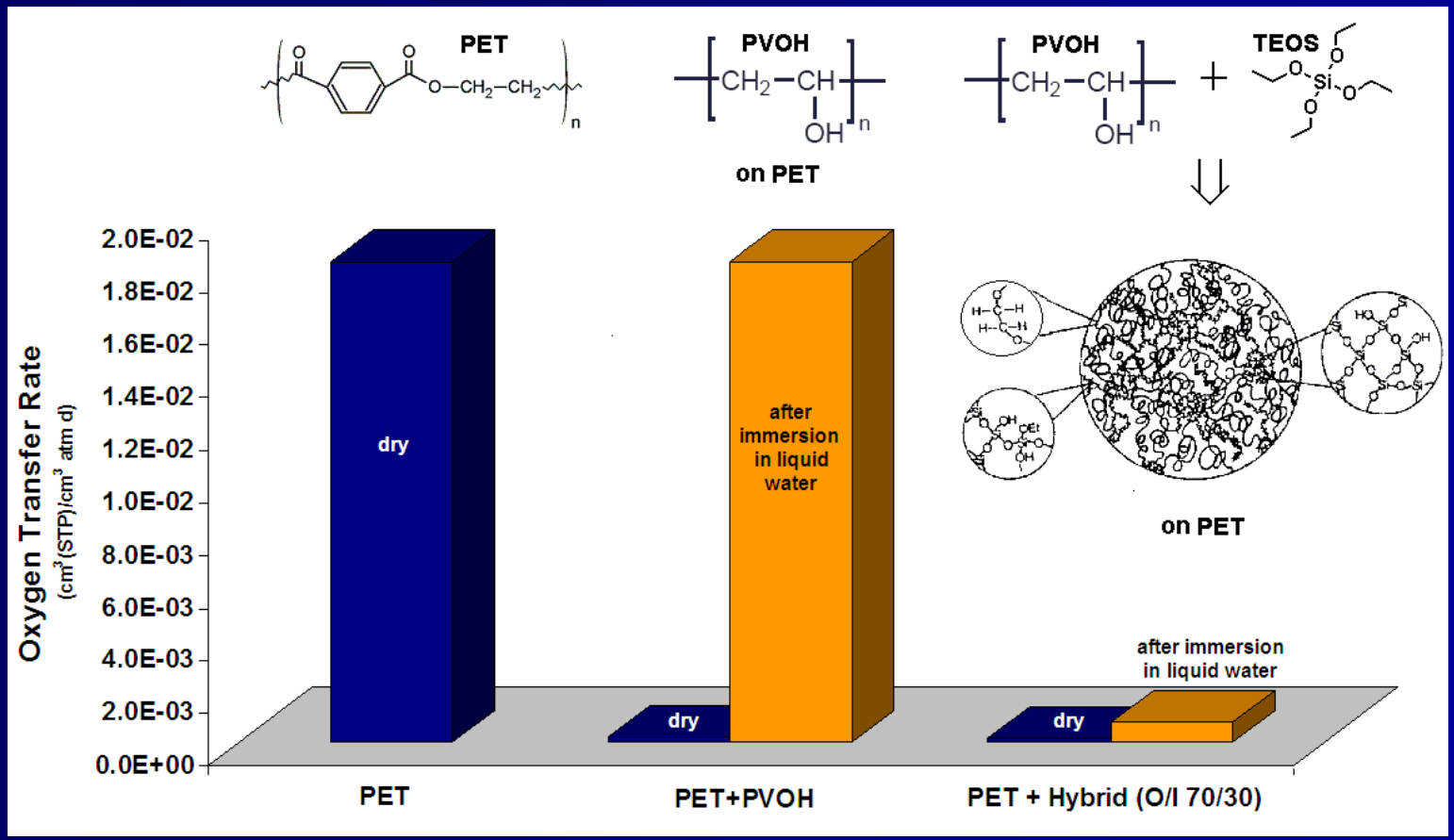
Some examples of experimental results

- Gas permeability of packaging films
- Gas and vapor transport in Ionomers
- Vapor sorption and swelling in polymers with FTIR-ATR Solvent-induced Stress
- Hydrogen permeability through Palladium-Silver membranes

Gas permeability of packaging films

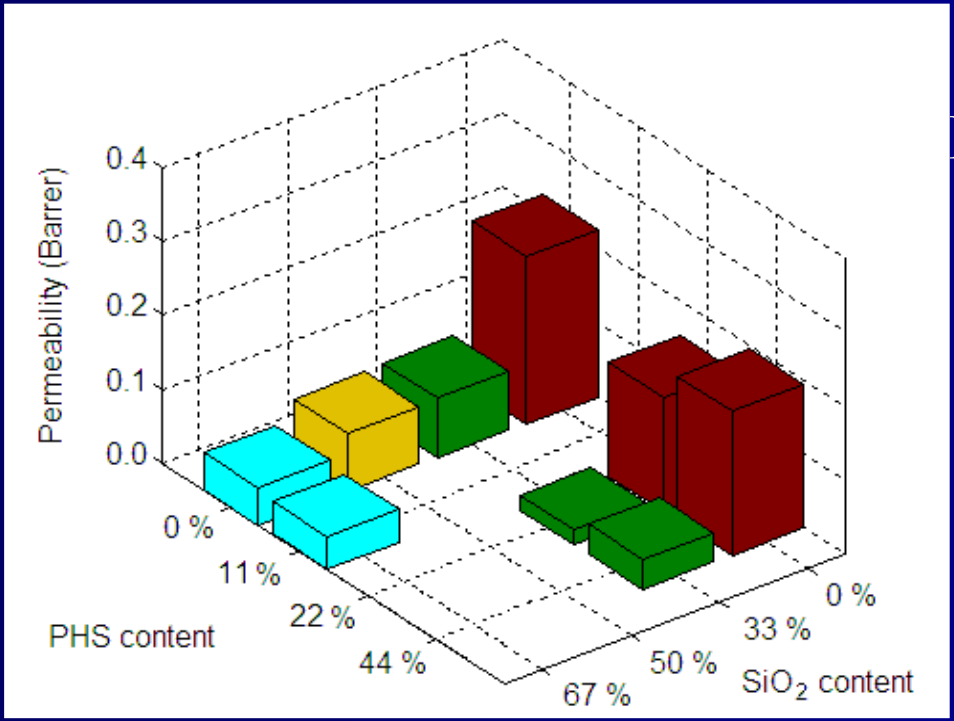
Hybrid nanostructured coating PVOH-SiO_2 obtained via sol-gel (on PET)

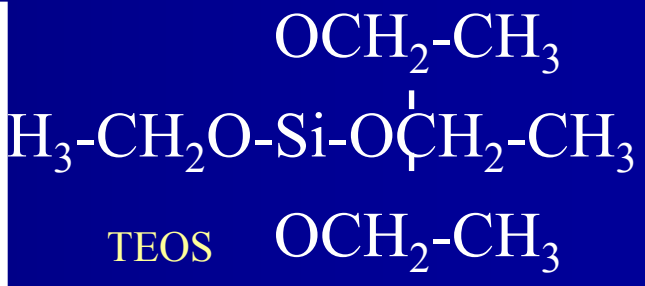


In collaboration with the University of Parma International Patent WO/2007/042993

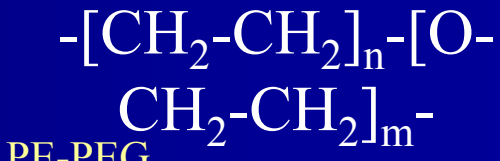
Gas permeability of packaging films

Hybrid nanostructured coating PE-PEG-PHS-SiO_2 obtained via sol-gel (on LDPE)

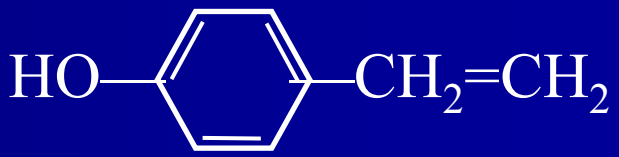




TEOS



PE-PEG



PHS

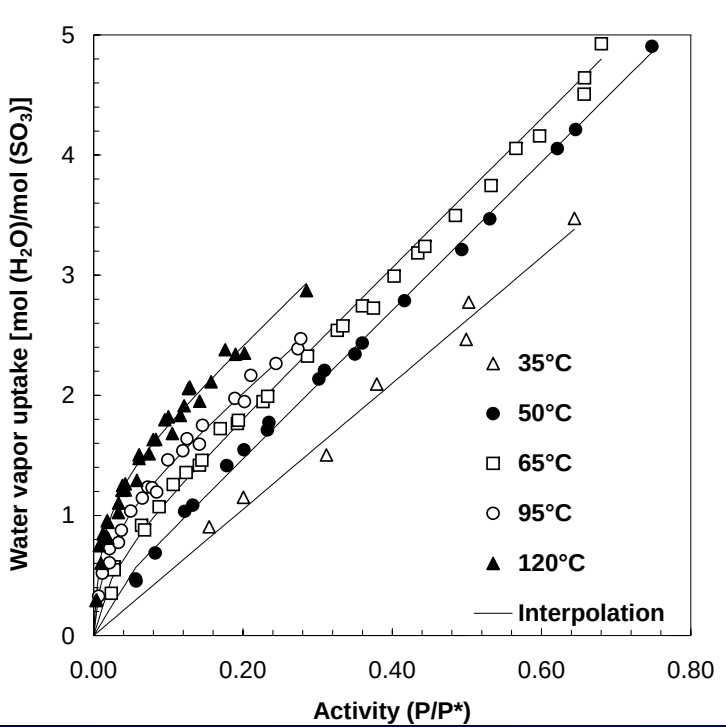
Minelli, M.; De Angelis, M.G.; Doghieri, F.; Marini, M.; Toselli, M.; Pilati, *European Polymer Journal*, v 44, n 8, 2008, p 2581-2588

Toselli, M.; Pilati, F.; Marini, M.; Doghieri, F.; De Angelis, M.G.; Minelli, M. *European Polymer Journal*, v 44, n 10, 2008, p 3256-3263

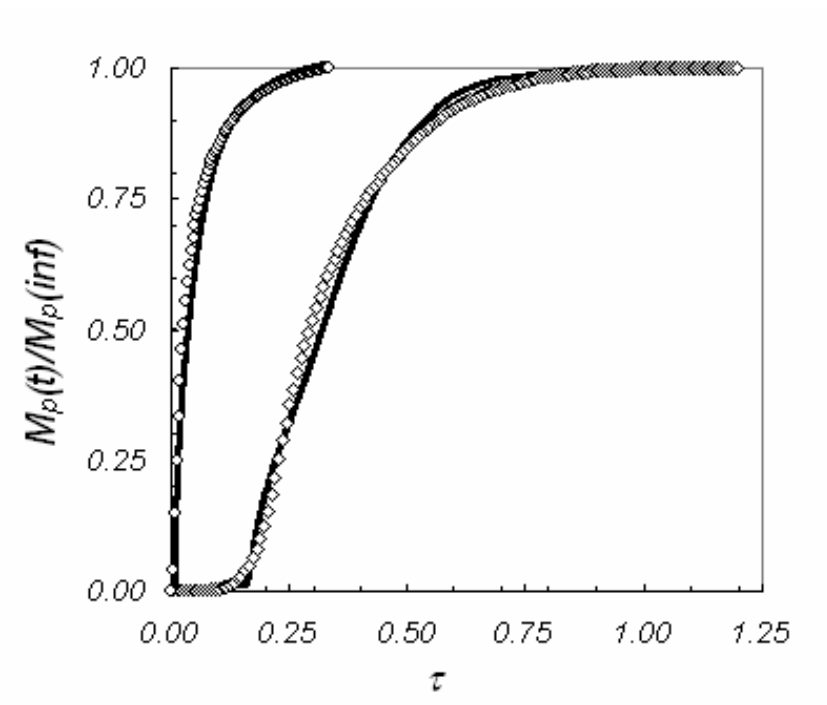
In collaboration with the University of Modena and Reggio Emilia and with DICASM of UNIBO

Gas and vapor transport in Ionomers

Water solubility isotherms in Hyflon Ion (EW=860 g_{pol}/mol(SO_3H)



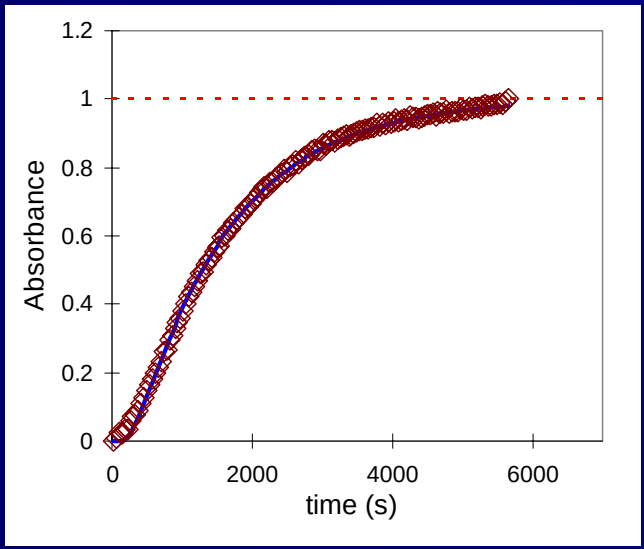
Transient water permeation in Hyflon Ion (EW=860 g_{pol}/mol(SO_3H)



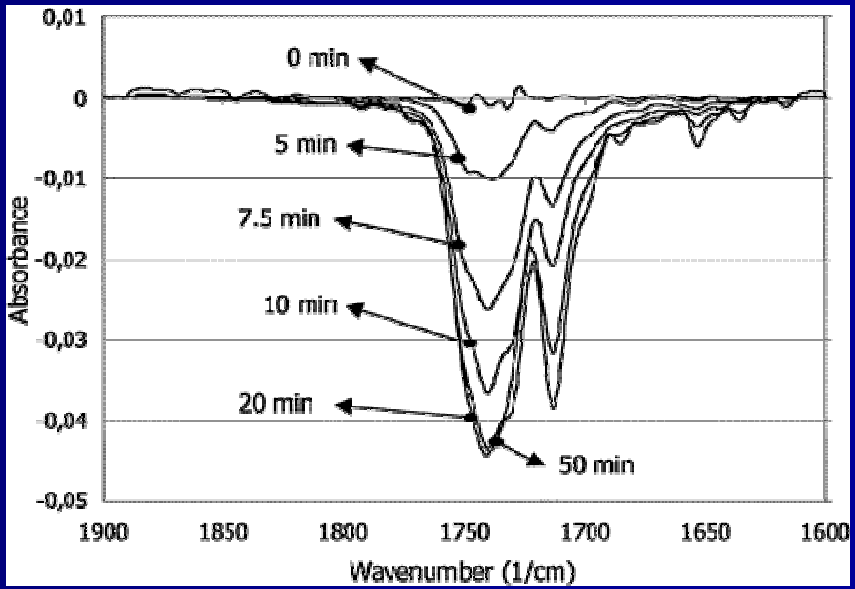
J. Catalano, M. Giacinti Baschetti, M.G. De Angelis, G.C. Sarti, A. Sanguineti, P. Fossati "Gas and water vapor permeation in a short-side-chain PFSI membrane"Desalination, in press (2009). D. Gorri, M.G. De Angelis, M. Giacinti Baschetti, G.C. Sarti Water and methanol permeation through short-side-chain perfluorosulphonic acid ionomeric membranes J Membrane Sci, 322 (2008) 383-391.M.G. De Angelis, S. Lodge, M. Giacinti Baschetti, G.C. Sarti, F. Doghieri, A. Sanguineti, P. Fossati Water sorption and diffusion in a short-side-chain perfluorosulfonic acid ionomer membrane for PEMFCS: effect of temperature and pre-treatment *Desalination* 193 (2006) 398-404. Y. Yamamoto, M.C. Ferrari, M. Giacinti Baschetti,M.G. De Angelis,G.C. Sarti, A quartz crystal microbalance study of water vapor sorption in a short side-chain PFSI membrane Desalination, 200, 2006, p 636-638

Vapor sorption and swelling in polymers with FTIR-ATR

Variation of absorbance with time corresponds to mass absorption



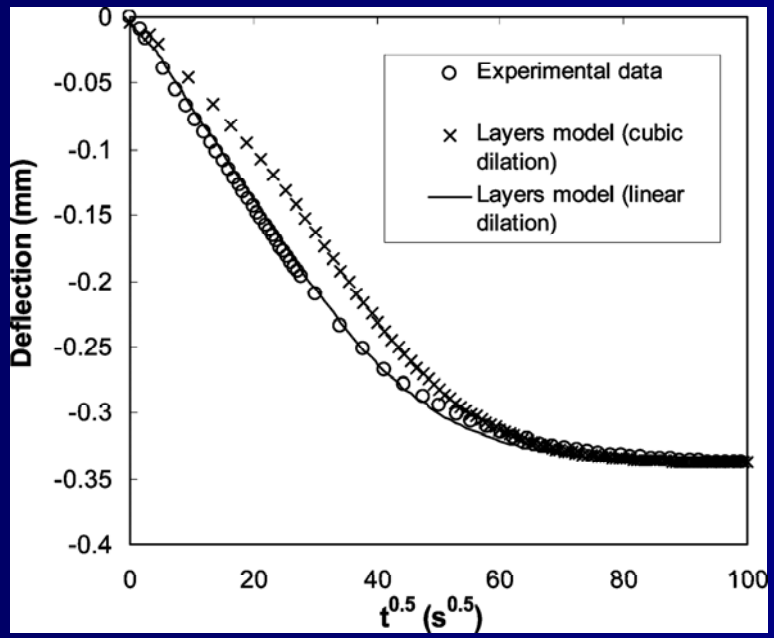
PVAc-Acetonitrile system: variation of absorbance with time (proportional to swelling)



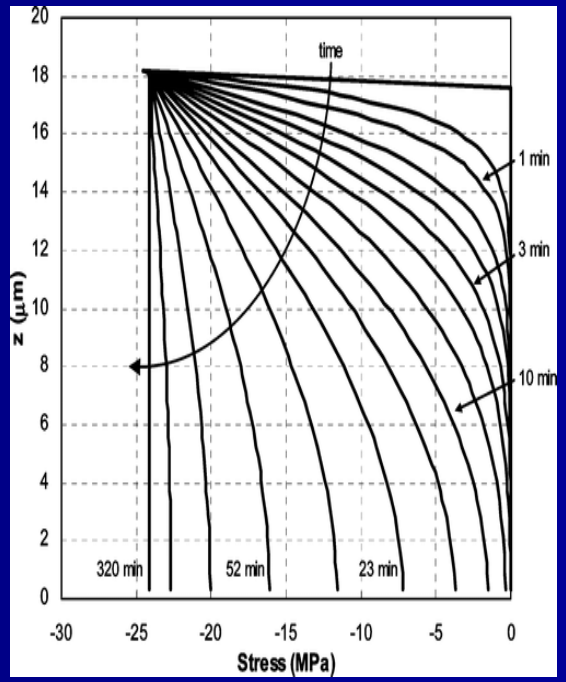
Time-Resolved Fourier Transform Infrared/Attenuated Total Reflection Spectroscopy for the Measurement of Molecular Diffusion in Polymers Elabd, Yossef A. Baschetti, Marco Giacinti; Barbari, Timothy A. Source: Journal of Polymer Science, Part B: Polymer Physics, v 41, n 22, Nov 15, 2003, p 2794-2807

Solvent-induced Stress

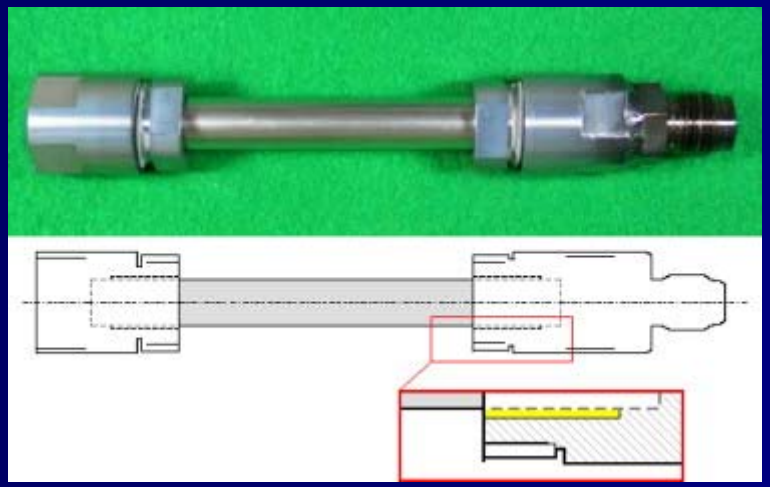
Variation of deflection with time of a polymer coated on a bending cantilever

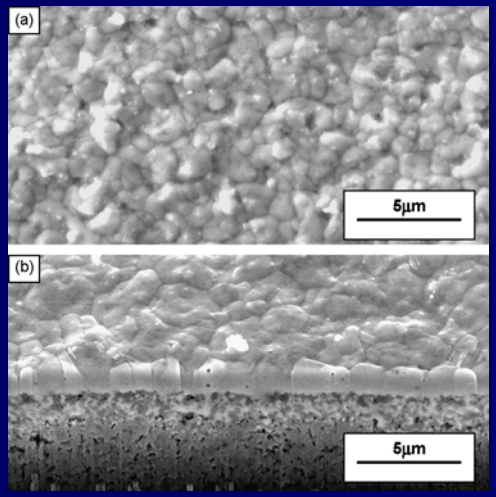


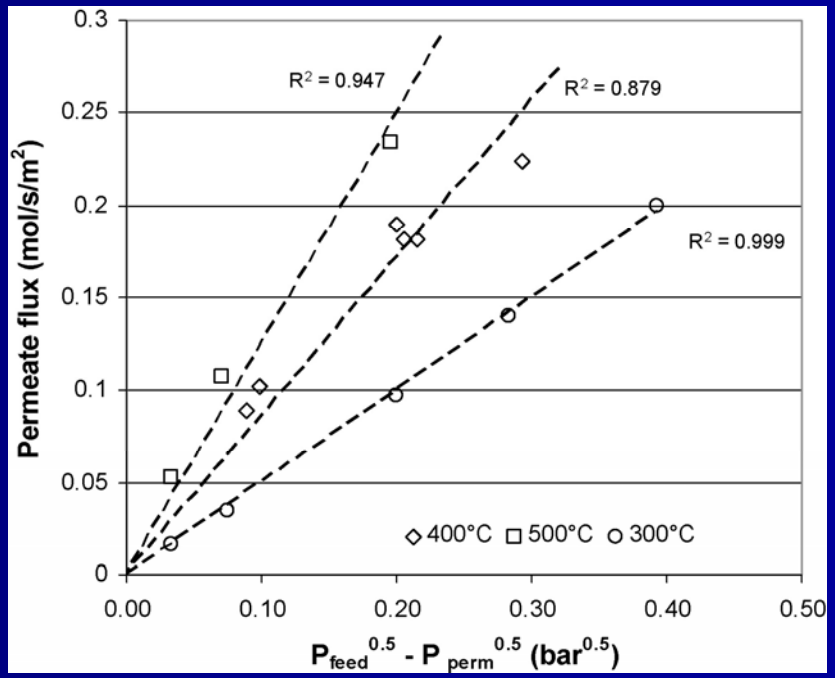
Time evolution of the stress profile inside a Polycarbonate film, during acetonitrile sorption



Hydrogen permeability through Palladium-Silver membranes







D. Pizzi, R. Worth, M. Giacvinti Baschetti, G.C: Sarti, K. Noda,Hydrogen permeability of 2.5 µm palladium-silver membranes deposited on ceramic supports Journal of Membrane Science, v 325, n 1, Nov 15, 2008, p 446-453

Selected Publications

•*J. Catalano, M. Giacinti Baschetti, M.G. De Angelis, G.C. Sarti, A. Sanguineti, P. Fossati* "Gas and water vapor permeation in a short-side-chain PFSI membrane"*Desalination, in press (2009).*

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•*M. Minelli, M.G. De Angelis, F. Doghieri, M. Marini, M. Toselli, F. Pilati* Oxygen permeability of novel organic-inorganic coatings: I. Effects of organic-inorganic ratio and molecular weight of the organic component*Eur. Pol. J. 44, 2581-2588 (2008).*

•*M. Toselli, F. Pilati, M. Marini, F. Doghieri, M.G. De Angelis and M. Minelli* Oxygen permeability of novel organic-inorganic coatings: II. Modification of the organic component with a hydrogen-bond forming polymer *Eur. Pol. J. 44, 3256-3263 (2008)* .

•*M.C. Ferrari, E. Piccinini, M. Giacinti Baschetti, F. Doghieri, G.C. Sarti*, Solvent-induced stresses during sorption in glassy polycarbonate: Experimental analysis and model simulation for a novel bending cantilever apparatus *Ind Eng Chem Res,47, 2008 1071-1080.*

•*D. Gorri, M.G. De Angelis, M. Giacinti Baschetti, G.C. Sarti* Water and methanol permeation through short-side-chain perfluorosulphonic acid ionomeric membranes J Membrane Sci, *322 (2008) 383-391.*

•*G. Malucelli, A. Priola, E. Amerio, A. Pollicino, G. di Pasquale, D. Pizzi, M. G. De Angelis, F. Doghieri* Surface and barrier properties of hybrid nanocomposites containing silica and PEO segments *J Appl Polym Sci 103, 6, 4107-4115 (2007)*

•*M.G. De Angelis, S. Lodge, M. Giacinti Baschetti, G.C. Sarti, F. Doghieri, A. Sanguineti, P. Fossati* Water sorption and diffusion in a short-side-chain perfluorosulfonic acid ionomer membrane for PEMFCS: effect of temperature and pre-treatment *Desalination 193 (2006) 398-404.*

•*Baschetti, M. Giacinti; Ghisellini, M.; Quinzi, M.; Doghieri, F.; Stagnaro, P.; Costa, G.; Sarti, G.C. Source:* Effects on sorption and diffusion in PTMSP and TMSP/TMSE copolymers of free volume changes due to polymer ageing *J. Molecular Structure, v 739, 2005, p 75-86*

•*R. S. Prabhakar, M. G. De Angelis, G. C. Sarti, B. D. Freeman, and M. C. Coughlin* "Gas and Vapor Sorption, Permeation, and Diffusion in Poly(tetrafluoroethylene-co-perfluoromethyl vinyl ether)", *Macromolecules 2005, 38, 7043-7055*

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