

WILLIAM J. KOROS
School of Chemical & Biomolecular Engineering
Georgia Institute of Technology
Atlanta, GA 30332

EDUCATION

The University of Texas	June 1969 B.S.	Chemical Engineering
The University of Texas	Dec. 1975 M.S.	Chemical Engineering
The University of Texas	Aug. 1977 Ph.D.	Chemical Engineering

EMPLOYMENT

1969-1973 Chemical Engineer, Polymer Processing Group, E. I. duPont Co.

1973-1977 Graduate School, University of Texas at Austin

1977-1980 Assistant Professor, ChE, North Carolina State University

1980-1983 Associate Professor, ChE, North Carolina State University

1983-1984 Professor, ChE, North Carolina State University

1984-2001 Professor, ChE, University of Texas at Austin

1986-1990 Paul D. & Betty Robertson Meek & American Petrofina Foundation Professor,
University of Texas at Austin

1990-1991 Z.D. Bonner Professor, University of Texas at Austin

1991-1993 Associate ChE Department Chairman, University of Texas at Austin

1993-1997 ChE Department Chairman, University of Texas at Austin

1991-2001 B. F. Goodrich Professor, University of Texas at Austin

2001- Roberto C. Goizueta Chair and Georgia Research Alliance Eminent Scholar in
Membranes, Georgia Institute of Technology

MEMBERSHIPS

National Academy of Engineering
American Association for the Advancement of Science
North American Membrane Society
American Chemical Society
American Institute of Chemical Engineers
American Society for Engineering Education
European Membrane Society
International Union of Pure and Applied Chemistry
Materials Research Society
Phi Kappa Phi
Registered Professional Engineer in Texas
Sigma Xi
Society of Plastics Engineering
TAPPI
Tau Beta Pi

HONORS

- 2006 R. M. Barrer Lecture on Microporous Materials, Pennsylvania State University
- 2005 Patten Distinguished Lecture, University of Colorado
- 2004 Chemcon Distinguished Lecturer Award, India-US Joint Meeting, Mumbai India
- 2004 Distinguished Visiting Professorship, Universidad Ibero-Americana, Mexico
- 2004 Selected Faculty Member of the Year by Georgia Tech Graduate Student Government
- 2003 Elected Fellow, American Association for the Advancement of Science
- 2002 Elected Fellow, American Institute of Chemical Engineers
- 2002 Listed, Who's Who in America
- 2000 Elected to National Academy of Engineering
- 2000 Distinguished Graduate Award, University of Texas College of Engineering
- 2000 Schechter-Wissler-Stice Undergraduate Teaching Award, University of Texas
- 1999 Clarence Gerhold AIChE Separations Division Award
- 1995 AIChE Institute Award for Excellence in Industrial Gases Technology
- 1991 Halliburton Engineering Faculty Leadership Award
- 1990 General Dynamics Outstanding Teaching Award
- 1989 Tau Beta Pi Outstanding Teaching Award
- 1988 University of Texas Outstanding Young Texas Ex Award
- 1987 Engineering Foundation Research Award
- 1984 NSF Presidential Young Investigator Award
- 1987 College of Engineering Faculty Leadership Award
- 1983 Alcoa Foundation Research Achievement Award (North Carolina State University)
- 1983 Tau Beta Pi Distinguished Chapter Advisor Award (North Carolina State University)
- 1980 Sigma Xi Outstanding Young Scientist Award (North Carolina State University)
- 1980 Outstanding Teacher Award (North Carolina State University)

BOARDS AND MEETING ORGANIZATION

- Editor-in-Chief, *Journal of Membrane Science*, (1991 – Present)
- Editor, Learning in Industry Feature, *Chemical Engineering Education* (1997 – Present)
- Editorial Board, *Polymer Contents* (2003 – Present)
- Editorial Advisory Board, *Industrial & Engineering Chemistry Research* (2006 – Present)
- North American Membrane Society, Secretary of Society (1987 – 2004)
- Editorial Board, *Journal of Macromolecular Science: Reviews in Macromolecular Chemistry and Physics* (1998 – 2004)
- International Membrane Conference, Chair- Gas & Gas-Liquid Separations, Sydney (2003)
- South African Chemical Engineering Congress Chair- Separations (2003)
- IUPAC Membrane Working Group, Co-Chair (1992 – 1997)
- Gordon Research Conference Chairman on Membranes (1989)

INVITED LECTURES (past 5 years)

- Plenary Lecture, 4th International Zeolite Membrane Meeting, Zaragoza, Spain, July 2007
- Plenary Lecture, 5th International Starch Technology Conference, Urbana, IL, June 2007
- Plenary Lecture, 23rd Polymer Processing Society Meeting, Salvador, Brazil, May, 2007
- Invited Lecture, Material Research Society, San Francisco, CA April, 2007
- Invited Lecture, AIChE Gerhold Award Session, San Francisco, CA, Nov. 2006
- Invited Lecture, Gordon Research Conference on Membranes, New London, NH, Aug, 2006
- Keynote Lecture, 4th Eastern Mediterranean ChE Conference, Israel, January, 2006.
- Plenary Lecture, International Congress on Membranes, ICOM 2005, Seoul, Korea, August 2005
- Plenary Lecture, North American Membrane Society, Annual Meeting, Chicaco, IL, May 2006

Keynote Lecture, 8th International Conference of Frontiers of Polymers & Advanced Materials, Cancun, Mexico, April 2005.

Keynote Lecture, 3rd International Zeolite Membrane Meeting, Breckenridge, CO, July 2004.

Keynote Lecture, 5th International Membrane Science & Technology Conference, Sydney, Australia, November 2003.

Keynote Lecture, South African Chemical Engineering Congress, South Africa, September 2003.

Keynote Lecture, EMS 2003 Summer School, Trondheim, Norway, August 2003.

Keynote Lecture, TAPPI PLACE Conference, Boston, MA, September 2002.

Invited Lecture, Gordon Research Conference on Membranes, New London, NH, August 2002.

Invited Lecture, 25th Asilomar Conference on Polymers, Pacific Grove, CA, February 2002

CITATIONS

Over 9000 listed by Science Citation Index as of April, 2008.

Listed in 1000 Most Cited Chemists 1981-1997 (<http://www.ill.fr/dif/citations/chemists.html>).

RESEARCH FOCUS

Research interests include membranes, barrier packaging and novel sorbents. Research within my group involves thermodynamically-controlled partitioning of penetrants and tailoring of diffusive motion of penetrants throughout various environments. Advanced materials that require optimization of the composition of materials to either promote or retard the uptake, diffusion or permeation of specific components is of particular interest to my group. Besides the chemical nature of the substrates, the detailed morphology must be tailored. The ability to control highly asymmetric morphologies in hollow fibers is an area of special strength. Recent work on "mixed matrix" materials comprising blends of molecular sieving entities within the matrix of a second material, which requires added issues of interfacial engineering, is also of particular interest.

PUBLICATIONS

Edited Books:

1. Barrier Polymers and Barrier Structures, ACS Symposium Series #423, Edited, 1990, 393 pages.

Contributed Book Chapters:

2. Chern, R. T., W. J. Koros, E. S. Sanders, S. H. Chen and H. B. Hopfenberg, "Implications of the dual mode and transport models for mixed gas permeation", ACS Symposium Series 223 on Industrial Gas Separations, Ed. by T. E. Whyte, C. M. Yon and E. H. Wagener, American Chemical Society, Washington DC, p.47 (1983) .
3. Iler, L., W. J. Koros, D. K. Yang and R. E. Yui, "Sorption and transport of physically and chemically interacting penetrants in Kapton® polyimide", Polyimides: Synthesis, Characterization and Applications, Ed. by K. L. Mittal, Plenum New York, Vol. 1, p. 443 (1984).
4. Chern, R. T., W. J. Koros, H. B. Hopfenberg and V. T. Stannett, "Material selection for gas separations using membranes", ACS Symposium Series No. 269: Materials Science

- of Synthetic Membranes, Ed. by D. R. Lloyd, American Chemical Society, Washington DC, Chapter 2 (1985).
5. Koros, W. J. and D. R. Paul, "Current aspects of membrane-based separation of gases", Synthetic Membranes, Ed. by M. B. Chenoweth, Harwood Academic New York, pp. 155-190 (1986).
 6. Koros, W. J. and R. T. Chern, "Separation of gaseous mixtures using polymer membranes", Handbook of Separation Process Technology, Ed. by R. W. Rousseau, John Wiley and Sons, New York, Chapter 20 (1987).
 7. Koros, W. J., "Membranes and membrane processes", Encyclopedia of Chemical Processing and Design, Ed. by J. J. McKetta, Marcel Dekker, New York, Vol. 29 (1988).
 8. Koros, W. J. and M. W. Hellums, "Transport properties", Encyclopedia of Polymer Science, 2nd Edition, Ed. by J. I. Kroschwitz, Wiley-Interscience, New York, Supplement Volume 724 (1989).
 9. Koros, W. J., ed. "Barrier polymers and structures: overview", ACS Symposium Series No. 423, American Chemical Society, Washington DC, Chapter 1 (1990).
 10. Woods, D., D. Walker and W. J. Koros, "Membrane separation", CRC- Engineering Handbook, Ed. by R. C. Dorf, CRC, Boca Raton, Chapter 61 (1994).
 11. Koros, W. J. and I. Pinnau, "Membrane formation for gas separation processes", Polymeric Gas Separation Membranes, Ed. by D. R. Paul and Y. P. Yampol'skii, CRC, Boca Raton, Chapter 5 (1994).
 12. Moaddeb. M. and W.J. Koros, "Gas barrier polymers", Polymeric Materials Encyclopedia: Synthesis, Properties, and Applications, Ed. by J. C. Salamone, CRC, Boca Raton (1996).
 13. Mahajan, R., C. M. Zimmerman and W. J. Koros, "Fundamental and practical aspects of mixed matrix gas separation membranes", ACS Symposium Series No. 733, Ed. by B. D. Freeman and I. Pinnau, American Chemical Society, Washington DC, pp. 277-286 (1999).
 14. Koros, W. J. and D. Punsalan, "Diffusion in polymer glasses", Encyclopedia of Materials: Science and Technology, Ed. K. H. Jurgens Buschow...[et al.], Elsevier Science Editors, Amsterdam, Vol. 8, pp. 7305-7315 (2001).
 15. Lee, E. K. and W. J. Koros, "Membranes, synthetic, applications", Encyclopedia of Physical Science and Technology, 3rd Edition, Ed. R. A. Meyers, Academic, New York pp. 279-345 (2002).
 16. Koros, W. J. and C. M. Zimmerman, "Transport and barrier properties", Comprehensive Desk Reference of Polymer Characterization and Analysis (Chemistry), Ed. R. F. Brady, Oxford University, pp. 680-699 (2003).
 17. Koros, W. J. and W. Madden, "Transport properties", Encyclopedia of Polymer Science and Technology Volume 12, 3rd Edition, Ed. H. F. Mark and J. I. Kroschwitz, John Wiley & Sons Incorporated, pp. 291-381 (2004).

18. Moore, T. T., S. Damle, D. Wallace, and W. J. Koros, "Membrane separation", The Engineering Handbook, 2nd Edition, Ed. R. C. Dorf, CRC, pp. 63-1-63-15 (2004).

Refereed Journal Publications:

19. Koros, W. J., R. P. Kuhlman, D. A. Dalrymple, and N. F. Brockmeir, "Crystallization of sodium chloride in a continuous mixed-suspension crystallizer", AIChE Symposium Series No. 121, **68**, 67-73 (1972).
20. Paul, D. R. and W. J. Koros, "Effect of partially immobilizing sorption on permeability and diffusion time lag", J. Polym. Sci.: Part B: Polym. Phys., **14**, 675-85 (1976).
21. Koros, W. J., D. R. Paul and A. Rocha, "Carbon dioxide sorption and transport in polycarbonate", J. Polym. Sci.: Part B: Polym. Phys., **14**, 687-702 (1976).
22. Koros, W. J. and D. R. Paul "Design considerations for measurement of gas sorption in polymers by pressure decay", J. Polym. Sci.: Part B: Polym. Phys., **14**, 1903-7 (1976).
23. Koros, W. J., D. R. Paul, M. Fujii, H. B. Hopfenberg and V. T. Stannett, "Effect of pressure on CO₂ transport in poly(ethylene terephthalate)", J. Appl. Polym. Sci., **21**, 2899-904 (1977).
24. Koros, W. J., A. Chan and D. R. Paul, "Sorption and transport of various gases in polycarbonate", J. Membr. Sci., **2**, 165-90 (1977).
25. Chan, A., W. J. Koros, and D. R. Paul, "Analysis of hydrocarbon gas sorption and transport in ethyl cellulose using the dual mode sorption/partial immobilization models", J. Membr. Sci., **3**, 117-3- (1978).
26. Koros, W. J. and D. R. Paul, "CO₂ sorption in poly(ethylene terephthalate) above and below the glass transition", J. Polym. Sci.: Part B: Polym. Phys., **16**, 1947-63 (1978).
27. Koros, W. J. and D. R. Paul, "Transient and steady-state permeation in poly(ethylene terephthalate) above and below the glass transition", J. Polym. Sci.: Part B: Polym. Phys., **16**, 2171-87 (1978).
28. Koros, W. J. and H. B. Hopfenberg, "Small molecule migration in products derived from glassy polymers", I&EC Product Research and Dev., **18**, 353-8 (1979).
29. Stannett, V. T., W. J. Koros, D. R. Paul, R. Baker and H. Lonsdale, "Recent advances in membrane science and technology", Adv. in Polym. Sci., **32**, 69-121 (1979).
30. Koros, W. J., D. R. Paul and G. S. Huvard, "Energetics of gas sorption in glassy polymers", Polymer, **20**, 956-60 (1979).
31. Koros, W. J. and H. B. Hopfenberg, "Scientific aspects of migration of indirect additives from plastics to food", Food Technology, **33**, 56-60 (1979).
32. Koros, W. J. and D. R. Paul, "Sorption and transport of CO₂ above and below the glass transition of poly(ethylene terephthalate)" Polym. Engr. and Sci., **20**, 14-19 (1980).

33. Stannett, V. T., M. Haider, W. J. Koros and H. B. Hopfenberg, "Sorption and transport of water vapor in glassy poly(acrylonitrile)", Polym. Engr. and Sci., **20**, 300-4 (1980).
34. Huvard, G. S., V. T. Stannett, W. J. Koros and H. B. Hopfenberg, "The pressure dependence of CO₂ sorption and permeation in poly(acrylonitrile)", J. Membr. Sci., **6**, 185-201 (1980).
35. Yi-Yan, N., R. M. Felder and W. J. Koros, "Selective permeation of hydrocarbon gases in poly(tetrafluoroethylene) and poly(fluoroethylene/propylene) copolymer", J. Appl. Polym. Sci., **25**, 1755-74 (1980).
36. Ranade, G., V. T. Stannett and W. J. Koros, "Temperature dependence and energetics of the equilibrium sorption of water vapor in glassy poly(acrylonitrile)", J. Appl. Polym. Sci., **25**, 2179-86 (1980).
37. Koros, W. J., "Model for sorption of mixed gases in glassy polymers", J. Polym. Sci.: Part B: Polym. Phys., **18**, 981-92 (1980).
38. Koros, W. J., C. J. Patton, R. M. Felder and S. J. Fincher, "Kinetics and equilibria of sulfur dioxide sorption in Kapton® polyimide", J. Polym. Sci.: Part B: Polym. Phys., **18**, 1485-95 (1980).
39. Felder, R. M., J. Wang and W. J. Koros, "Reduction of the oxygen effect in flame ionization detection", J. Environ. Sci. Health, **A16(2)**, 157-74 (1981).
40. Koros, W. J., G. N. Smith and V. T. Stannett, "High pressure sorption of carbon dioxide in solvent cast poly(methyl methacrylate) and poly(ethyl methacrylate) films", J. Appl. Polym. Sci., **26**, 159-70 (1981).
41. Hopfenberg, H. B., M. Z. Ward, R. D. Rierson, and W. J. Koros, "The effect of component partitioning on potassium picrate transport across multicomponent supported liquid membranes", J. Membr. Sci., **8**, 91-101 (1981).
42. Fechter, J.M.H., H. B. Hopfenberg and W. J. Koros, "Characterization of glassy state relaxations by low pressure carbon dioxide sorption in poly(methyl methacrylate)", Polym. Engr. and Sci., **21**, 23-5 (1981).
43. Koros, W. J., R. T. Chern, V. T. Stannett and H. B. Hopfenberg, "A model for permeation of mixed gases and vapors in glassy polymers", J. Polym. Sci.: Part B: Polym. Phys., **19**, 1513-30 (1981).
44. Koros, W. J. and D. R. Paul, "Observations concerning the temperature dependence of the Langmuir sorption capacity of glassy polymers", J. Polym. Sci.: Part B: Polym. Phys., **19**, 1655-6 (1981).
45. Koros, W. J., J. Wang, and R. M. Felder, "Oxygen permeation through PFEP Teflon® and Kapton® polyimide", J. Appl. Polym. Sci., **26**, 2805-9 (1981).
46. Felder, R. M., C. J. Patton and W. J. Koros, "Dual mode sorption and transport of sulfur dioxide in Kapton® polyimide", J. Polym. Sci.: Part B: Polym. Phys., **19**, 1895-909 (1981).

47. Stannett, V. T., G. Ranade and W. J. Koros, "Characterization of water vapor transport in glassy polyacrylonitrile by combined permeation and sorption techniques", J. Membr. Sci., **10**, 219-33 (1982).
48. Koros, W. J., V. T. Stannett and H. B. Hopfenberg, "Estimation of the effective permeability of thin surface layers created by exposure of polyethylene to fluorine", Polym. Engr. and Sci., **22**, 738-46 (1982).
49. Iler, L. R., R. C. Laundon and W. J. Koros, "Characterization of penetrant interactions in Kapton* polyimide using a gravimetric sorption technique", J. Appl. Polym. Sci., **27**, 1163-75 (1982).
50. Sanders, E. S., W. J. Koros, H. B. Hopfenberg and V. T. Stannett, "Mixed gas sorption in glassy polymers: Equipment design considerations and preliminary results", J. Membr. Sci., **13**, 161-74 (1983).
51. Duncan, T., W. J. Koros and R. M. Felder, "Permeation of methyl chloride and benzene through FEP Teflon®", J. Appl. Polym. Sci., **28**, 209-18 (1983).
52. Chern, R. T., W. J. Koros, H. B. Hopfenberg and V. T. Stannett, "Reversible isopentane-induced depression of carbon dioxide permeation through polycarbonate", J. Polym. Sci.: Part B: Polym. Phys., **21**, 753-63 (1983).
53. Ayres, J. L., J. L. Osborne, H. B. Hopfenberg and W. J. Koros, "Effect of variable storage times on the calculation of diffusion coefficients characterizing small molecule migration in polymers", I&EC Product Research and Dev., **22**, 86-9 (1983).
54. Osborne, J. L., G. C. Sarti, W. J. Koros and H. B. Hopfenberg, "Zero migration of monomers in glassy polymers: a possible artifact of thermal depolymerization", Polym. Engr. and Sci., **23**, 473-88 (1983).
55. Chern, R. T., W. J. Koros, E. S. Sanders and R. E. Yui, "Second component' effects in sorption and permeation of gases in glassy polymers", J. Membr. Sci., **15**, 157-69 (1983).
56. Patton, C. J., R. M. Felder and W. J. Koros, "Sorption and transport of benzene in poly(ethylene terephthalate)", J. Appl. Polym. Sci., **29**, 1095-110 (1984).
57. Sanders, E. S., W. J. Koros, H. B. Hopfenberg and V. T. Stannett, "Pure and mixed gas sorption of carbon dioxide and ethylene in poly(methyl methacrylate)", J. Membr. Sci., **18**, 53-74 (1984).
58. Kamlet, M. J., R. M. Doherty, R. W. Taft, M. H. Abraham and W. J. Koros, "Solubility properties in polymers and biological media. Part 3. Prediction methods for critical temperatures, boiling points and solubility properties (R_G values) based on molecular size, polarizability and dipolarity", J. Am. Chem. Soc., **106**, 1205-12 (1984).
59. Chern, R. T., W. J. Koros, H. B. Hopfenberg and V. T. Stannett, "Selective permeation of CO₂ and CH₄ through Kapton® polyimide: effects of penetrant competition and gas phase nonidealities", J. Polym. Sci.: Part B: Polym. Phys., **22**, 1061-84 (1984).

60. Koros, W. J., H. Al Hussani, H.B. Hopfenberg and M. Howard, "A simple apparatus for measurement of liquid permeability through polymeric films", I&E.C. Prod. Res. and Dev., **23**, 317-20 (1984).
61. Koros, W. J., D. K. Yang and V. T. Stannett "Sorption and transport studies of water in Kapton® Polyimide films: as-received films" J. Appl. Polym. Sci., **30**, 1035-47 (1985).
62. Chern, R. T., W. J. Koros and P. S. Fedkiw, "Simulation of a hollow fiber gas separator: effects of process and design variables", I&E.C. Prod. Des. and Dev., **24**, 1015-22 (1985).
63. Koros, W. J., "Simplified analysis of gas/polymer selective solubility behavior", J. Polym. Sci.: Part B: Polym. Phys., **23**, 1611-28 (1985).
64. Koros, W. J. and E. S. Sanders, "Multicomponent gas sorption in glassy polymers", J. Polym. Sci., Polym. Symp., **72**, 141-9 (1985).
65. Sanders, E. S. and W. J. Koros, "Sorption of CO₂, C₂H₄, N₂O and their binary mixtures in poly(methyl methacrylate)", J. Polym. Sci.: Part B: Polym. Phys., **24**, 175-88 (1986).
66. Yang, D. K., W. J. Koros, H. B. Hopfenberg and V. T. Stannett, "The effects of morphology and hygrothermal aging on water sorption and transport in Kapton® polyimide", J. Appl. Polym. Sci., **31**, 1619-29 (1986).
67. Fleming, G. K. and W. J. Koros, "Dilation of polymers by sorption of carbon dioxide at elevated pressures: silicone rubber and unconditioned polycarbonate", Macromolecules, **19**, 2285-91 (1986).
68. O'Brien, K. C., W. J. Koros, T. A. Barbari and E. S. Sanders, "A new technique for the measurement of multicomponent gas transport through polymer films", J. Membr. Sci., **29**, 229-38 (1986).
69. Uragami, T., W. J. Koros, H. B. Hopfenberg, D. K. Yang and V. T. Stannett, "Dual mode analysis of subatmospheric pressure carbon dioxide sorption and transport in Kapton® polyimide films", J. Polym. Sci.: Part B: Polym. Phys., **24**, 779-92 (1986).
70. Koros, W. J., B. J. Story, S. M. Jordan, K. C. O'Brien, and G. R. Husk, "Material selection for gas separation processes", Polym. Engr. and Sci., **27**, 603-10 (1987).
71. Jordan, S. M., W. J. Koros and G. K. Fleming, "The effects on carbon dioxide exposure on pure and mixed gas permeation behavior of polymers: comparison of glassy polycarbonate and silicone rubber", J. Membr. Sci., **30**, 191-212 (1987).
72. O'Brien, K. C., G. R. Husk and W. J. Koros, "Influence of casting and curing conditions on gas sorption and transport in polyimide films", Polym. Engr. and Sci., **27**, 211-17 (1987).
73. Fleming, G. K. and W. J. Koros, "Comments on measurements of gas-induced polymer dilation by different optical methods", J. Polym. Sci.: Part B: Polym. Phys., **25**, 2033-8 (1987).
74. Connelly, R., N. R. McCoy, H. B. Hopfenberg, M. E. Stewart and W. J. Koros, "The effect of sorbed penetrants on the aging of previously dilated glassy polymer powders.

- Part I: lower alcohols and water sorption in polystyrene”, J. Appl. Polym. Sci., **34**, 703-19 (1987).
75. McCoy, N. R., H. B. Hopfenberg, M. E. Stewart and W. J. Koros, “The effect of sorbed penetrants on the aging of previously dilated glassy polymer powders. Part II: n-propane sorption in polystyrene”, J. Appl. Polym. Sci., **34**, 721-35 (1987).
 76. Stewart, M. E., H. B. Hopfenberg, N. R. McCoy and W. J. Koros, “The effect of sorbed penetrants on the aging of previously dilated glassy polymer powders. Part III: The effect of exposure to lower alcohols during aging on enthalpy relaxations in PMMA”, J. Appl. Polym. Sci., **34**, 2493-505 (1987).
 77. Abraham, M. H., P. L. Grellier, R. A. Doherty, R. M. Kamlett, T. H. Hall, R. W. Taft, P. W. Carr and W. J. Koros, “The solubility of gaseous solutes in polymers in terms of solute-polymer interactions”, Polymer, **28**, 1363-9 (1987).
 78. Kim, T. H., W. J. Koros, G. R. Husk and K. C. O'Brien, “Reverse permselectivity of nitrogen over methane in aromatic polyimides”, J. Appl. Polym. Sci., **34**, 1767-71 (1987).
 79. Muruganadam, N., D. R. Paul and W. J. Koros, “Gas sorption and transport in substituted polycarbonates”, J. Polym. Sci.: Part B: Polym. Phys., **25**, 1999-2026 (1987).
 80. Barbari, T. A., D. R. Paul and W. J. Koros, “Gas transport in polymers based on bisphenol-A”, J. Polym. Sci.: Part B: Polym. Phys., **26**, 709-27 (1988).
 81. Barbari, T. A., D. R. Paul and W. J. Koros, “Gas *sorption* in polymers based on bisphenol-A”, J. Polym. Sci.: Part B: Polym. Phys., **26**, 729-44 (1988).
 82. Koros, W. J., G. K. Fleming, S. M. Jordan, T. H. Kim and H. H. Hoehn, “Polymeric membrane materials for solution-diffusion based permeation separations”, Prog. Polym. Sci., **13**, 339-401 (1988).
 83. O'Brien, K. C., W. J. Koros and G. R. Husk, “Polyimide materials based on pyromellitic dianhydride for the separation of carbon dioxide and methane gas mixtures”, J. Membr. Sci., **35**, 217-30 (1988).
 84. Kim, T. H., W. J. Koros, G. R. Husk and K. C. O'Brien, “Relationship between gas separation properties and chemical structure in a series of aromatic polyimides”, J. Membr. Sci., **37**, 45-62 (1988).
 85. Moe, M. B., W. J. Koros and D. R. Paul, “Effects of molecular structure and thermal annealing on gas transport in two tetramethyl bisphenol-A-polymers”, J. Polym. Sci.: Part B: Polym. Phys., **26**, 1931-45 (1988).
 86. Moe, M., W. J. Koros, H. H. Hoehn and G. R. Husk, “Effects of film history on gas transport in a fluorinated aromatic polyimide”, J. Appl. Polym. Sci., **36**, 1833-46 (1988).
 87. Kim, T. H., W. J. Koros and G. R. Husk, “Advanced gas separation membrane materials: rigid aromatic polyimides”, Seprn. Sci. and Techn., **23**, 1611-26 (1988).
 88. Barbari, T. A., D. R. Paul and W. J. Koros, “Polymeric membranes based on bisphenol-A for gas separations”, J. Membr. Sci., **42**, 69-86 (1989).

89. Jordan, S. M., W. J. Koros and J. K. Beasley, "Characterization of CO₂-induced conditioning of polycarbonate films using penetrants with different solubilities", J. Membr. Sci., **43**, 103 (1989).
90. Pope, D. S., W. J. Koros and G. K. Fleming, "Measurement of thickness dilation in polymer films", J. Polym. Sci.: Part B: Polym. Phys., **27**, 1173-7 (1989).
91. Koresh, J. E., T. H. Kim and W. J. Koros, "Study of ultramicroporous carbons by high pressure sorption. Part I. Nitrogen, carbon dioxide, oxygen, and helium isotherms", J. Chem. Soc., Trans. Faraday Soc. 1, **85**, 1537-44 (1989).
92. Koresh, J. E., T. H. Kim, D. R. B. Walker and W. J. Koros, "Study of ultramicroporous carbons by high pressure sorption. Part II. nitrogen diffusion kinetics", J. Chem. Soc., Trans. Faraday Soc. 1, **85**, 1545-56 (1989).
93. Koresh, J. E., T. H. Kim, D. R. B. Walker and W. J. Koros, "Study of ultramicroporous carbons by high pressure sorption. Part III. Complex transport phenomena as sensed by carbon dioxide & nitrogen kinetics", J. Chem. Soc., Trans. Faraday Soc. 1, **85**, 1557-44 (1989).
94. Kim, T. H., W. J. Koros and G. R. Husk, "Temperature effects on gas permselection properties in hexafluoro aromatic polyimides", J. Membr. Sci., **46**, 43-56 (1989).
95. Stewart, M. E., W. J. Koros and H. B. Hopfenberg, "Characterization of physical aging of poly(methyl methacrylate) powders by a novel high pressure sorption technique", J. Appl. Polym. Sci., **38**, 1111-26 (1989).
96. Hellums, M. W., W. J. Koros, G. R. Husk, and D. R. Paul, "Fluorinated polycarbonates for gas separation applications", J. Membr. Sci., **46**, 93-112 (1989).
97. Story, B. J. and W. J. Koros, "Comparison of three models for permeation of carbon dioxide/methane mixtures in poly(phenylene oxide)", J. Polym. Sci.: Part B: Polym. Phys., **27**, 1927-48 (1989).
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