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EDUCATION:

Ph.D. Chemical Engineering - January 1988
University of California, Berkeley
Thesis: "The Effect of Hydrostatic Pressure on Mutual Diffusion Coefficients in Polymer Solutions" Thesis Directors: Morton M. Denn and David S. Soane

B.S. Chemical Engineering - May 1983 *Summa Cum Laude*
North Carolina State University
Graduate of Engineering Honors Program

PROFESSIONAL EXPERIENCE:

The University of Texas at Austin:

William J. (Bill) Murray, Jr. Endowed Chair in Engineering, September 2019 – present.
Richard B. Curran Centennial Chair of Engineering, September 2012 – August 2019.
Paul D. and Betty Robertson Meek & American Petrofina Foundation Centennial Professor of Chemical Engineering, September 2007 to August 2012.
Kenneth A. Kobe Professor of Chemical Engineering, September 2005 to August 2012.
Matthew van Winkle Professor of Chemical Engineering, September 2002 to August 2005.
Professor of Chemical Engineering, January 2002 to present.

NC State University:

Professor of Chemical Engineering, November 1997 to January 2002.
Sabbatical Leave, July 2000 to December 2000. University of California, Berkeley.
Associate Department Head, August 1996 to January 2002.
Associate Professor of Chemical Engineering, August 1994 to November 1997.
Assistant Professor of Chemical Engineering, August 1989 to August 1994.

NATO Postdoctoral Fellow, March 1988 to July 1989, Ecole Supérieure de Physique et de Chimie Industrielles de la Ville de Paris (ESPCI), Laboratoire Physico-Chimie Structurale et Macromoléculaire, 10 rue Vauquelin, 75231 Paris, France. Research directed by Professor Lucien Monnerie and Professor Liliane Bokobza.

Graduate Student, August 1983 to January 1988, Univ. of California, Berkeley.

Summer Technical Hire, E.I. duPont, Inc. Brevard, NC, Summers of 1981, 1982, and 1983.

HONORS AND AWARDS:

AIChE Separations Division Founders Award 2022
Reilley Lectureship, University of Notre Dame 2020
Membrane Society of Australasia (MSA) Distinguished Scholar Lectureship 2019
American Chemical Society POLY Fellow 2019
American Chemical Society POLY/PMSE Plenary Lecture 2019
Bird, Stewart, and Lightfoot Lecture, University of Wisconsin 2019
North American Membrane Society (NAMS) Fellow 2017
Fulbright Distinguished Chair 2016-2017

PMSE Distinguished Service Award (from Polymeric Materials: Science and Engineering Division of ACS) 2015
World Premier International (WPI) Professor of International Institute for Carbon-Neutral Energy Research (I^2CNER) at Kyushu University, Japan 2014-2023
Fellow of the Industrial and Engineering Chemistry Research Division of ACS 2014
AIChE Clarence (Larry) G. Gerhold Award 2013
Joe J. King Professional Engineering Achievement Award 2013
Society of Plastics Engineers (SPE) International Award 2013
Roy W. Tess Award in Coatings (from PMSE Division of ACS) 2012
AAAS Fellow 2011
ACS Fellow 2011
AIChE Fellow 2011
Fellow of the PMSE Division of ACS 2010
ACS Award in Applied Polymer Science 2009
American Institute of Chemical Engineers (AIChE) Institute Award for Excellence in Industrial Gases Technology 2008
IBM Faculty Award 2008, 2012
University CO-OP Research Excellence Award for Best Research Paper in 2006 2007
American Chemical Society (ACS) PMSE Cooperative Research Award 2002
National Academy of Engineering Frontiers of Engineering – Japan Symposium 2002
Strategic Environmental Research and Development Program Project of the Year 2001
Japan Society for the Promotion of Science Fellowship 1997, 2001
Alcoa Foundation Distinguished Engineering Research Award 2000
National Technological University Outstanding Teaching Certificate 2000
Academy of Outstanding Teachers 1997
College of Engineering Outstanding Teaching Award 1997
United Technologies Excellence in Teaching Award 1997
ALCOA Foundation Research Achievement Award 1996
National Academy of Engineering Frontiers of Engineering Symposium 1995
NSF Young Investigator Award 1992-1996
3M Nontenured Faculty Grant Award 1991-1994
NATO Postdoctoral Fellowship 1987
Berkeley Outstanding Graduate Instructor 1986
NSF Graduate Fellowship 1984
Berkeley Fellowship 1983
Phi Kappa Phi Fellowship 1983
P.V. Danckwerts Senior Research Prize in Chemical Engineering 1983
Eastern NC Section AIChE Award 1983
Special Service Award from NC Alpha Chapter of Tau Beta Pi 1983
E.I. duPont Ph.D. Fellowship 1982
Allied Merit Scholarship 1982
SOHIO Merit Scholarship 1981

EXTERNAL PROFESSIONAL ACTIVITIES:

American Chemical Society

Member of Executive Committee, Polymeric Materials: Science and Engineering (PMSE) Division [served as Program Chair, Ford Travel Grant Chair, Member at Large, and Chair of the On-line Preprints Committee]	1994 – present
Vice Chair, PMSE Division	2003 – 2004
Chair, PMSE Division	2005
Past Chair, PMSE Division	2006

Alternate Councilor for PMSE Division	2008 – 2010
Councilor for PMSE Division	2011 – 2022

American Institute of Chemical Engineers

Vice Chair of Membranes Area of Separations Division	2002 – 2003
Chair of Membranes Area of Separations Division	2003 – 2004
Co-organizer of Topical Conference on Membranes	2003
Director of Separations Division	2003 – 2008
Second Vice Chair of the Separations Division	2009
First Vice Chair of the Separations Division	2010
Chair of the Separations Division	2011
Past-Chair of the Separations Division	2012
Member, Separations Division Nominating Committee	2017
Co-organizer of Topical Conference on Water Technologies for Developed and Developing Countries	2011
Member, AIChE Fellows Admission Committee	2013 – 2018
Second Vice Chair, AIChE Fellows Admission Committee	2015
First Vice Chair, AIChE Fellows Admission Committee	2016
Chair, AIChE Fellows Admission Committee	2017

North American Membrane Society

Vice President	2004 – 2005
President	2005 – 2006
Member, Board of Directors	2001 – 2012
Technical Program Chair of Annual Meeting	2004
Co-Chair of International Congress on Membranes (ICOM)	2008

Other

Vice Chair of the Gordon Research Conference on Membranes: Materials & Processes	2002
Chair of the Gordon Research Conference on Membranes: Materials & Processes	2004

JOURNAL EDITORIAL ACTIVITIES:

Editor-in-Chief, *Polymer* ..... 2020 – present
Senior Editor, *Polymer* 2019
Member, Editorial Board, *Industrial & Engineering Chemistry Research* ..... 2020 – present
Member, Editorial Board, *ACS Macro Letters* ..... 2020 – present
Member, Editorial Board, *ACS Applied Polymer Materials* ..... 2020 – present
Member, Editorial Board, *Polymer* ..... 2011 – 2019
Member, Editorial Board, *Desalination* ..... 2009 – 2013
Member, Editorial Board, *Polymers* ..... 2009 – present
Member, International Editorial Advisory Board, *Int. Journal of Polymer Science* ..... 2008 – present
Associate Editor, *Industrial & Engineering Chemistry Research* ..... 2007 – 2019
Member, Editorial Board, *The Open Macromolecules Journal* ..... 2007 – present
Member, Editorial Board, *Journal of Membrane Science* ..... 2005 – present
Member, Editorial Board, *Journal of Applied Membrane Science and Technology* ..... 2005 – present
Member, International Editorial Advisory Board, *Membrane Journal* ..... 2003 – present
Member, International Editorial Advisory Board, *Korean Membrane Journal* ..... 2003 – present

BOOKS:

1. B.D. Freeman and Y. Yampolskii, Membrane Gas Separation, John Wiley & Sons, Ltd., New York (2010).
2. Y.P. Yampolskii, I. Pinnau, and B.D. Freeman, Materials Science of Membranes for Gas and Vapor Separation, John Wiley & Sons, Ltd., New York (2006).
3. I. Pinnau and B.D. Freeman, Editors, Advanced Materials for Membrane Separations, ACS Symposium Series Volume 876, American Chemical Society, Washington, DC (2004).
4. I. Pinnau and B.D. Freeman, Editors, Membrane Formation and Modification, ACS Symposium Series Volume 744, American Chemical Society, Washington, DC (2000).
5. B.D. Freeman and I. Pinnau, Editors, Polymeric Membranes for Gas and Vapor Separations: Chemistry and Materials Science, ACS Symposium Series Volume 733, American Chemical Society, Washington, DC (1999).

PUBLICATIONS: Researcher ID: G-5405-2016, Orcid ID: orcid.org/0000-0003-2779-7788

1. Cheng, Y.-H., A. Kirschner, C.-C. Chang, Z. He, M. Nassr, T. Emrick, and B. Freeman, "Surface Modification of Ultrafiltration Membranes with 1, 4-Benzoquinone and Polyetheramines to Improve Fouling Resistance," *ACS Applied Materials & Interfaces*, *in press*.

2. Marioni, N., Z. Zhang, E. Zofchak, H. Sachar, S. Kadulkar, B. Freeman, and V. Ganesan, "Impact of ion-ion correlated motion on salt transport in solvated ion exchange membranes," *ACS Macro Letters*, *in press*.

3. Rylski, A.K., H.L. Cater, K.S. Mason, M.J. Allen, A.J. Arrowood, B.D. Freeman, G.E. Sanoja, and Z.A. Page, "Polymeric Multimaterials by Photochemical Patterning of Crystallinity," *Science*, **378(6616)**, 211-215 (2022).

4. Gokturk, P.A., R. Sujanani, J. Qian, Y. Wang, L. Katz, B.D. Freeman, and E.J. Crumlin, "The Donnan Potential Revealed," *Nature Communications*, **13**, 5880 (2022).

5. Bridge, A.T., M.S. Santoso, J.A. Maisano, A.V. Hillsley, J.F. Brennecke, and B.D. Freeman, "Rapid Macrovoid Characterization in Membranes Prepared via Nonsolvent-induced Phase Separation: A Comparison Between 2D and 3D Techniques," *Journal of Membrane Science,* **661**, 120923 (2022).

6. Hou, R., C. Fong, B.D. Freeman, M.R. Hill, and Z. Xie, "Current Status and Advances in Membrane Technology for Carbon Capture," *Separation and Purification Technology*, **300**, 121863 (2022).

7. Pedretti, B.J., N.J. Czarnecki, C. Zhu, J. Imbrogno, F. Rivers, B.D. Freeman, V. Ganesan, and N.A. Lynd, "Structure−Property Relationships for Polyether-Based Electrolytes in the High-Dielectric-Constant Regime," *Macromolecules*, **55**, 6730-6738 (2022).

8. Soto, C., J. Carmona, B.D. Freeman, L. Palacio, A. González-Ortega, P. Prádanos, Á.E. Lozano, and A. Hernandez, "Free Volume and Permeability of Mixed Matrix Membranes Made from Terbutil-M-terphenyl Polyamide and a Porous Polymer Network," *Polymers*, **14**, 3176 (2022).

9. Cater, H.L., I. Balynska, M.J. Allen, B.D. Freeman, and Z.A. Page, "User Guide to Ring-Opening Metathesis Polymerization of *endo*-Norbornene Monomers with Chelated Initiators," *Macromolecules,* **55**, 6671-6679 (2022).

10. Song, W., J. Park, S. Dasgupta, C. Yao, N. Maroli, H. Behera,X. Yin, D.P. Acharya, X. Zhang, C.M. Doherty, P.K. Maiti, B.D. Freeman, and M. Kumar, "Scalable Pillar[5]arene-Integrated Poly(arylate-amide) Molecular Sieve Membranes to Separate Light Gases," *Chemistry of Materials,* **34**, 6559-6567 (2022).

11. Rodriguez, K.M. W.-N. Wu, T. Alebrahim, Y. Cao, B.D. Freeman, D. Harrigan, M. Jhalaria, A. Kratochvil, S. Kumar, W.H. Lee, Y.M. Lee, H. Lin, J.M. Richardson, Q. Song, B. Sundell, R. Thür, I. Vankelecom, A. Wang, C. Wiscount, J. Xingming, and Z.P. Smith, *"*Multi-lab Study on the Pure-gas Permeation of Commercial Polysulfone (PSf) Membranes: Measurement Standards and Best Practices," *Journal of Membrane Science*, **659**, 120746 (2022).

12. Gokturk, P.A., R. Sujanani, J. Qian, Y. Wang, L. Katz, B.D. Freeman, and E.J. Crumlin, "The Donnan Potential Revealed," *Nature Communications*, *in press*.

13. Sachar, H., E. Zofchak, N. Marioni, Z. Zhang, S. Kadulkar, T. Duncan, B. Freeman, and V. Ganesan, "Impact of Cation-Ligand Interactions on the Permselectivity of Ligand-Functionalized Polymer Membranes in Single and Mixed Salt Systems," *Macromolecules*, **55**, 4821-4831 (2022).

14. Park, S., O. Morales-Collazo, B. Freeman, and J.F. Brennecke, "Ionic Liquid Stabilizes Olefin Facilitated Transport Membranes Against Reduction," *Angewandte Chemie International Edition*, **61(25)**, e202202895 (1 of 8) (2022).

15. Yan, N., R. Sujanani, J. Kamcev, E.-S Jang, K Kobayashi, D.R. Paul, and B.D. Freeman, "Salt and Ion Transport in a Series of Crosslinked AMPS/PEGDA Hydrogel Membranes," *Journal of Membrane Science*, **653**, 120549 (2022).

16. Zofchak, E.S., Z. Zhang, N. Marioni, T. Duncan, H. Sachar, A. Chamseddine, B. Freeman, and V. Ganesan, "Cation-ligand Interactions Dictate Salt Partitioning and Diffusivity in Ligand-functionalized Polymer Membranes," *Macromolecules*, **55**, 2260-2270 (2022).

17. Davenport, M.N., C.L. Bentley, J.F. Brennecke, and B.D. Freeman, "Ethylene and Ethane Transport Properties of Hydrogen-stable Ag^{+}-based Facilitated Transport Membranes," *Journal of Membrane Science*, **647**, 120300 (2022).

18. Yan, N., R. Sujanani, J. Kamcev, M. Galizia, E.-S. Jang, D.R. Paul, and B.D. Freeman, "Influence of Fixed Charge Concentration and Water Uptake on Ion Sorption in AMPS/PEGDA Membranes," *Journal of Membrane Science*, **644**, 120171 (2022).

19. Bridge, A.T., B.J. Pedretti, J.F. Brennecke, and B.D. Freeman, "Preparation of Defect-free Asymmetric Gas Separation Membranes with Dihydrolevoglucosenone (Cyrene^{TM}) as a Greener Polar Aprotic Solvent," *Journal of Membrane Science*, **644**, 120173 (2022).

20. Soto, C., E.S. Torres-Cuevas., L. Palacio, P. Prádanos, B.D. Freeman, A.E. Lozano, A. Hernández, and B. Comesaña-Gándara, "Gas Permeability, Fractional Free Volume and Molecular Kinetic Diameters: The Effect of Thermal Rearrangement on ortho-hydroxy Polyamide Membranes Loaded with a Porous Polymer Network," *Membranes*, **12**, 200 (2022).

21. Hou, R., N.T. Eden, C. Fong, D. Acharya, C.M. Doherty, T. Gengenbach, K. Konstas, Z. Xie, B.D. Freeman, and M.R. Hill, "Enhanced Membrane Performance for Gas Separation by Coupling Effect of the Porous Aromatic Framework (PAF) Incorporation and Photo-Oxidation," *Industrial & Engineering Chemistry Research*, 61, 6190-6199 (2022).

22. Hou, R., S.J.D. Smith, K. Konstas, C.M. Doherty, C.D. Easton, J. Park, H. Yoon, H. Wang, B.D. Freeman, and Matthew R. Hill, "Synergistically Improved PIM-1 Membrane Gas Separation Performance by PAF-1 Incorporation and UV Irradiation," *Journal of Materials Chemistry*, A, **10**, 10107-10119 (2022).

23. Wang, H., L.O. Jones, I. Hwang, M. Allen, D. Tao, V.M. Lynch, B.D. Freeman, N.M. Khashab, G.C. Schatz, Z.A. Page, and J.L. Sessler, "Selective Separation of Lithium Chloride by Organogels Containing Strapped Calix[4]pyrroles," *Journal of the American Chemical Society*, **143**, 20403-20410 (2021).

24. J. Park, J.W. Yoon, M. Nassr, M.R. Hill, D.R. Paul, and B.D. Freeman, "Pure-and Mixed-gas Transport Properties of a Microporous Tröger's Base Polymer (PIM-EA-TB) Polymer," *Polymer*, 124295 (2021).

25. Zofchak, E.S., Z. Zhang, B. Wheatle, T. Dilenschneider, R. Sujanani, K. Hanson, S. Warnock, S. Zhao, S. Mukherjee, M. Abu-Omar, C. Bates, B. Freeman, and V. Ganesan, "Origins of Lithium/Sodium Reverse Permeability Selectivity in 12-Crown-4-Functionalized Polymer Membranes," *ACS Macro Letters*, **10(9)**, 1167-1173 (2021).

26. Warnock, S.J., R. Sujanani, E.S. Zofchak, S. Zhao, T.J. Dilenschneider, K.G. Hanson, S. Mukherjee, V. Ganesan, B.D. Freeman, M.M. Abu-Omar, and C.M. Bates, "Engineering Li/Na Selectivity in 12-Crown-4-functionalized Polymer Membranes," *Proceedings of the National Academy of Sciences (PNAS)*, **21(37)**, e2022197118 (2021).

27. Moon, J.D., H. Borjigin, R. Liu, R.M. Joseph, J.S. Riffle, B.D. Freeman, and D.R. Paul, "Impact of Humidity on Gas Transport in Polybenzimidazole Membranes," *Journal of Membrane Science*, **639**, 119758 (2021).

28. Landsman, M.R., F. Rivers, B.J. Pedretti, B.D. Freeman, D.F. Lawler, N.A Lynd, and L.E. Katz, "Boric Acid Removal with Polyol-functionalized Polyether Membranes," *Journal of Membrane Science*, **638**, 119690 (2021).

29. Sujanani, R., L.E. Katz, D.R. Paul, and B.D. Freeman, "Aqueous Ion Partitioning in Nafion: Applicability of Manning's Counter-ion Condensation Theory," *Journal of Membrane Science*, **638**, 119687 (2021).

30. Allen M., R. Sujanani, A. Chemseddine, B. Freeman, and Z. Page, "Mechanically Robust Hydrophobized Double Network Hydrogels and Their Fundamental Salt Transport Properties," *Journal of Polymer Science*, **59**, 2581-2589 (2021).

31. Allen M., R. Sujanani, A. Chemseddine, B. Freeman, and Z. Page, "Mechanically Robust Hydrophobized Double Network Hydrogels for Water Purification, *ChemRxiv*, Posted on 16 April 2021, https://doi.org/10.26434/chemrxiv.14428091.v1.

32. Yu, Y., N. Yan, B.D. Freeman, and C.-C. Chen, "Mobile Ion Partitioning in Ion Exchange Membranes Immersed in Saline Solutions," *Journal of Membrane Science*, **620**, 118760 (2021).

33. Nguyen, A.L.P., T.G. Mason, B.D. Freeman, and E.I. Izgorodina, "Prediction of Lattice Energy of Benzene Crystals: A Robust Theoretical Approach," *Journal of Computational Chemistry*, **42**, 248-260 (2021).

34. Moon, J.D., R. Sujanani, Z. Geng, B.D. Freeman, R.A. Segalman, and C.J. Hawker, "Versatile Synthetic Platform for Polymer Membrane Libraries Using Functional Networks," *Macromolecules*, **54(2)**, 866-873 (2021).

35. Park, J., H. Ha, H.W. Yoon, J. Noh, Ho Bum Park, D.R. Paul, C.J. Ellison, and B.D. Freeman, *"*Gas Sorption and Diffusion in Poly(dimethylsiloxane) (PDMS)/Graphene Oxide (GO) Nanocomposite Membranes*," Polymer,* **212**, 123185 (2021).

36. Soto, C., E.S. Torres-Cuevas, A. González-Ortega, L. Palacio, Á.E. Lozano, B.D. Freeman, and P. Prádanos, Gas Separation by Mixed Matrix Membranes with Porous Organic Polymer Inclusions within *o*-Hydroxypolyamides Containing *m*-Terphenyl Moieties," *Polymers*, **13(6)**, 931 (2021).

37. Chen, G.Q., K. Wei, A. Hassanvand, B.D. Freeman, and S.E. Kentish, "Single and Binary Ion Sorption Equilibria of Monovalent and Divalent Ions in Commercial Ion Exchange Resins," *Water Research*, **175**, 115681 (2020); Erratum published in vol. **196**, 117110 (2021).

38. Merrick, M.M., R. Sujanani, and B.D. Freeman, "Glassy Polymers: Historical Findings, Membrane Applications, and Unresolved Questions Regarding Physical Aging," *Polymer*, **211**, 123176 (2020).

39. Park, J., K.E. Gaines, L.C. Jheng, S.J. Mecham, J.E. McGrath, H.B. Park, "Characterization and Gas Transport Properties of UV-irradiated Polydimethylsiloxane (PDMS)-containing Polyimide Copolymer Membranes," *Polymer*, 122966 (2020).

40. Sujanani, R., M.R. Landsman, S. Jiao, J.D. Moon, M.S. Shell, D.F. Lawler, L.E. Katz, and B.D. Freeman, "Designing Solute-Tailored Selectivity in Membranes: Perspectives for Water Reuse and Resource Recovery," *ACS Macro Letters*, **9**, 1709-1717 (2020).

41. Park, S., B.D. Freeman, and J.F. Brennecke, "Influence of Physicochemical Properties on Gas Transport Properties of Silver-Containing Ionic Liquid Mixtures for Olefin/Paraffin Membrane Separations," *ECS Transactions*, *98(10)*, 385-392 (2020).

42. Ricci, E., F.M. Benedetti, M.E. Dose, M.G. De Angelis, B.D. Freeman, and D.R. Paul, "Competitive Sorption in CO_2/CH_4 Separations: the Case of HAB/6FDA Polyimide and its TR derivative and a General Analysis of Its Impact on the Selectivity of Glassy Polymers at Multicomponent Conditions," *Journal of Membrane Science*, 612, 118374 (2020).

43. Galizia, M., D.R. Paul, and B.D. Freeman, "Co-ion Specific Effect on Sodium Halides Sorption and Transport in a Cross-linked Poly(p-styrene sulfonate-co-divinylbenzene) for Membrane Applications," *Journal of Membrane Science*, 612, 118410 (2020).

44. Moon, J.D., B.D. Freeman, C.J. Hawker, and R.A. Segalman, "Can Self-Assembly Address the Permeability/Selectivity Trade-Offs in Polymer Membranes?," *Macromolecules*, **53(14)**, 5649-5654 (2020).

45. Brennecke, J.F. and B.D. Freeman, "Reimagining Petroleum Refining," *Science*, **369(6501)**, 254-255 (2020).

46. Roh, J.S., H. Lee, T.H. Lee, H.W. Yoon, T.H. Choi, S.-H. Do, S.Y. Yoo, B. Freeman, T. Song, U. Paik, H.B. Park, "Unprecedentedly Low CO_2 Transport through Vertically Aligned, Conical Silicon Nanotube Membranes," *Nano Letters*, **20(7)**, 4754-4760 (2020).

47. Park, J., H.W. Yoon, D.R. Paul, and B.D. Freeman, "Gas Transport Properties of PDMS-coated Reverse Osmosis Membranes," *Journal of Membrane Science*, **604,** 118009 (2020).

48. Rodriguez, C.G., M. Chwatko, J. Park, C.L. Bentley, B.D. Freeman, and N.A. Lynd, "Compositionally Controlled Polyether Membranes via Mono (μ-alkoxo) bis (alkylaluminum)-Initiated Chain-Growth Network Epoxide Polymerization: Synthesis and Transport Properties," *Macromolecules*, **53(4)**, 1191-1198 (2020).

49. Freeman, B.D., "Polymer: Looking Forward," *Polymer*, 122312 (2020).

50. Yoon, H.W., T.H. Lee, C.M. Doherty, T.H. Choi, J.S. Roh, H.W. Kim, Y.H. Cho, S.-H. Do, B.D. Freeman, and H.B. Park, "Origin of CO_2-philic sorption by Graphene Oxide Layered Nanosheets and Its Derivatives," *Journal of Chemical Physics Letters*, **11**, 2356-2362 (2020).

51. Jang, E.-S., J. Kamcev, K. Kobayashi, N. Yan, R. Sujanani, T.J. Dilenschneider, H.B. Park, D.R. Paul, and B.D. Freeman, "Influence of Water Content on Alkali Metal Chloride Transport in Cross-Linked Poly(ethylene glycol) Diacrylate. 2. Ion Diffusion," *Polymer*, **192**, 122316 (2020).

52. Lu, J., H. Zhang, J. Hou, X. Li, X. Hu, Y. Hu, C.D. Easton, Q. Li, C. Sun, A.W. Thornton, M.R. Hill, X. Zhang, G. Jiang, J.Z. Liu, A.J. Hill, B.D. Freeman, L. Jiang, and H. Wang, "Efficient Metal Ion Sieving in Rectifying Subnanochannels Enabled by Metal Organic Frameworks," *Nature Materials*, **19(7)**, 767-774 (2020).

53. Landsman, M.R., R. Sujanani, S.H. Brodfuehrer, C.M. Cooper, A.G. Darr, R.J. Davis, K. Kim, S. Kum, L.K. Nalle, S.M. Nomaan, C.P. Oden, A. Paspureddi, K.K. Reimund, L.S. Rowles III, S. Yeo, D.F. Lawler, B.D. Freeman, and L.E. Katz, "Water Treatment: Are Membranes the Panacea?," *Annual Review of Chemical and Biomolecular Engineering*, **11:1**, 559-585 (2020). Erratum – p. 367-121.

54. Moon, J.D., M. Galizia, H. Borjigin, R. Liu, J.S. Riffle, B.D. Freeman, and D.R. Paul, "Modeling Water Diffusion in Polybenzimidazole Membranes Using Partial Immobilization and Free Volume Theory," *Polymer*, **189**, 122170 (2020).

55. Pérez-Francisco, J.M., J.L. Santiago-García, M.I. Loría-Bastarrachea, D.R. Paul, B.D. Freeman, and M. Aguilar-Vega, "CMS Membranes from PBI/PI Blends: Temperature Effect on Gas Transport and Separation Performance," *Journal of Membrane Science,* **597**, 117703 (2020).

56. Hill, A.J., A.W. Thornton, R.H.J. Hannink, J.D. Moon, and B.D. Freeman, "Role of Free Volume in Molecular Mobility and Performance of Glassy Polymers for Corrosion Protective Coatings," *Corrosion Engineering Science and Technology*, **55(20)**, 145-158 (2020).

57. Galizia, M. and B.D. Freeman, "Don Paul: 60 Years in Research and Education," *Industrial & Engineering Chemistry Research*, **59(12)**, 5203-5204 (2020).

58. Stevens, K.A., J.D. Moon, H. Borjigin, R. Liu, R.M. Joseph, J.S. Riffle, and B.D. Freeman, "Influence of Temperature on Gas Transport Properties of Tetraaminodiphenylsulfone (TADPS) based Polybenzimidazoles," *Journal of Membrane Science*, **593**, 117427 (2020).

59. Miguel Sanchez, C., T. Song, J. Brennecke, and B. Freeman, "Hydrogen Stable Supported Ionic Liquid Membranes with Silver Carriers: Propylene and Propane Permeability and Solubility," *Industrial & Engineering Chemistry Research*, **59(12)**, 5362-5370 (2020).

60. Freeman, B.D., "Reflecting on 12 Years as I&EC Research Associate Editor," *Industrial & Engineering Chemistry Research*, **58**, 21171-21172 (2019).

61. Jang, E.-S., J. Kamcev, K. Kobayashi, N. Yan, R. Sujanani, T.J. Dilenschneider, H.B. Park, D.R. Paul, and B.D. Freeman, "Influence of Water Content on Alkali Metal Chloride Transport in Cross-Linked Poly(ethylene glycol) Diacrylate. I. Ion Sorption," *Polymer*, **178**, 121554 (2019).

62. Li, X., P. Wang, J. Hou, J. Lu, C.D. Easton, X. Zhang, M. Hill, A. Thornton, J.Z. Liu, B. Freeman, A. Hill, L. Jiang, and H. Wang, "Fast and Selective Fluoride Conduction in Sub-1-nanometer Metal-Organic Framework Channels," *Nature Communications*, **10**, Article Number 2490 (2019).

63. Choudhury, S.R., O. Lane, D. Kazerooni, G.S. Narang, E.-S. Jang, B.D. Freeman, J.J. Lesko, and J.S. Riffle, "Synthesis and Characterization of Post-Sulfonated Poly(arylene ether sulfone) Membranes for Potential Applications in Water Desalination," *Polymer*, **177**, 250-261 (2019).

64. Moon, J.D., A.T. Bridge, C. D'Ambra, B.D. Freeman, and D.R. Paul, "Gas Separation Properties of Polybenzimidazole/Thermally-Rearranged Polymer Blends," *Journal of Membrane Science*, **582**, 182-193 (2019).

65. Jang, E.-S., W. Mickols, R. Sujanani. A. Helenic, T.J. Dilenschneider, J. Kamcev, D.R. Paul, and B.D. Freeman, "Influence of Concentration Polarization and Thermodynamic Non-ideality on Salt Transport in Reverse Osmosis Membranes," *Journal of Membrane Science*, **572**, 668-675 (2019).

66. Jang, E.-S., J. Kamcev, K. Kobayashi, N. Yan, R. Sujanani, S. Talley, R. Moore, D. Paul, B. Freeman, "Effect of Water Content on Sodium Chloride Sorption in Cross-Linked Cation Exchange Membranes," *Macromolecules*, **5265**, 2569-2579 (2019).

67. Galizia, M., G.S. Manning, D.R. Paul, and B.D. Freeman, "Ion Partitioning Between Brines and Ion Exchange Polymers," *Polymer*, **165**, 91-100 (2019).

68. Kirschner, A.Y., Y.-H. Cheng, D.R. Paul, R.W. Field, and B.D. Freeman, "Fouling Mechanisms in Constant Flux Crossflow Ultrafiltration, *Journal of Membrane Science*, **574**, 65-75 (2019).

69. Dose, M.E., M. Chwatko, I. Hubacek, N.A. Lynd, D.R. Paul, and B.D. Freeman, "Thermally Cross-linked Diaminophenylindane (DAPI) Containing Polyimides for Membrane Based Gas Separations," *Polymer*, **161**, 16-26 (2019).

70. Talebi, S., G.Q. Chen, B. Freeman, F. Suarez, A. Freckleton, K. Bathurst, and S.E. Kentish, "Fouling and *in-situ* Cleaning of Ion-Exchange Membranes During the Electrodialysis of Fresh Acid and Sweet Whey," *Journal of Food Engineering*, **246**, 192-199 (2019).

71. Moon, J.D., and B.D. Freeman, "Ordered Polymeric Membranes Using Metals," *Nature Materials*, **18**, 92-93 (2019).

72. Moon, J., M. Galizia, H. Borjigin, R. Liu, J. Riffle, B.D. Freeman, and D.R. Paul, "Water Vapor Sorption, Diffusion, and Dilation in Polybenzimidazoles," *Macromolecules*, **51(18)**, 7197-7208 (2018).

73. Kamcev, J., D.R. Paul, and B.D. Freeman, "Equilibrium Ion Partitioning Between Aqueous Salt Solutions and Inhomogeneous Ion Exchange Membranes," *Desalination*, **446**, 31-41 (2018).

74. Kamcev, J., C.M. Doherty, K. Lopez, A.J. Hill, D.R. Paul, and B.D. Freeman, "Effect of Fixed Charge Group Concentration on Salt Permeability and Diffusion Coefficients in Ion Exchange Membranes," *Journal of Membrane Science*, **566**, 307-316 (2018).

75. Musto, P., P. La Manna, J.D. Moon, M. Galizia, and B.D. Freeman, "Infrared Spectroscopy of Polybenzimidazole in the Dry and Hydrate Forms: A Combined Experimental and Computational Study," *ACS Omega*, **3**, 11592-11607 (2018).

76. Scholes, C.A., and B.D. Freeman, "Thermal Rearranged Poly(imide-co-ethylene glycol) Membranes for Gas Separation," *Journal of Membrane Science*, **563**, 676-683 (2018).

77. Joseph, R.M., M.M. Merrick, R. Liu, A.C. Fraser, J.D. Moon, S.R. Choudhury, J. Lesko, B.D. Freeman, and J.S. Riffle, "Synthesis and Characterization of Polybenzimidazole Membranes for Gas Separation with Improved Gas Permeability: A Grafting and Blending Approach," *Journal of Membrane Science*, **564**, 587-597 (2018).

78. Yan, N., D.R. Paul, and B.D. Freeman, "Water and Ion Sorption in a Series of Cross-linked AMPS/PEGDA Hydrogel Membranes," *Polymer*, **146**, 196-208 (2018).

79. Kamcev, J., D.R. Paul, G.S. Manning, and B.D. Freeman, "Ion Diffusion Coefficients in Ion Exchange Membranes: Significance of Counterion Condensation," *Macromolecules*, **51(15)**, 5519-5529 (2018).

80. Abdellah, M.H., C.A. Scholes, B.D. Freeman, L. Liu, and S.E. Kentish, "Transport of Terpenes Through Composite PDMS/PAN Solvent Resistant Nanofiltration Membranes," *Separation and Purification Technology*, **207**, 470-476 (2018).

81. Narang, G.S., J.D. Moon, W. Zhang, G.C. Miller, S.R. Choudhury, A. Shaver, B. Vondrasek, J.J. Lesko, J.J. Fallon, M. Bortner, C. D'Ambra, B.D. Freeman, and J.S. Riffle, "Synthesis and Characterization of a Phosphine Oxide Based Poly(arylene ether ketone) and Blends with Poly(2,6-dimethyl-1,4-phenylene oxide) for Gas Separations," *Polymer*, **138**, 156-168 (2018).

82. McGinnis, R.L, K. Reimund, J. Ren, L. Xia, M.R. Chowdhury, X. Sun, M. Abril, J.D. Moon, M.M. Merrick, J. Park, K.A. Stevens, J.R. McCutcheon, and B.D. Freeman, "Large Scale Polymeric Carbon Nanotube Membranes with Sub-1.27 nm Pores," *Science Advances*, **4**, e1700938 (2018).

83. Zhang, H., J. Hou, Y. Hu, P. Wang, R. Ou, L. Jiang, J.Z. Liu, B.D. Freeman, A.J. Hill, H. Wang, "Ultrafast Selective Transport of Alkali Metal Ions in Metal Organic Frameworks with Subnanometer Pores," *Science Advances*, **4(2)**, eaaq0066 (2018).

84. Kamcev, J., R. Sujanani, E.-S. Jang, Ni Yan, N. Moe, D. R. Paul, and B. D. Freeman, "Salt Concentration Dependence of Ionic Conductivity in Ion Exchange Membranes," *Journal of Membrane Science*, **547**, 123-133 (2018).

85. Puertas-Bartolomé, M., M.E. Dose, P. Bosch, B.D. Freeman, J.E. McGrath, J.S. Riffle, A.E. Lozano, J.G. de la Campa, and C. Àlvarez, Aromatic Poly(ether ether ketone)s Capable of Crosslinking via UV Irradiation to Improve Gas Separation Performance, *RSC Advances*, **7**, 55371–55381, (2017).

86. Daryaei, A., E.-S. Jang, S.R. Choudhury, D. Kazerooni, J.J. Lesko, B.D. Freeman, J.S. Riffle, and J.E. McGrath, "Structure-Property Relationships of Crosslinked Disulfonated Poly(arylene ether sulfone) Membranes for Desalination of Water", *Polymer*, **132**, 286-293 (2017).

87. Shaver, A., J.D. Moon, D. Savacool, W. Zhang, G. Narang, G. Miller, B. Vondrasek, J.J. Lesko, B. D. Freeman, J.S. Riffle, and J.E. McGrath, "Poly(2,6-dimethyl-1,4-phenylene oxide) Blends with a Poly(arylene ether ketone) for Gas Separation Membranes," *Polymer*, **114**, 135-143 (2017).

88. Galizia, M., W.S. Chi, Z.P. Smith, T.C. Merkel, R.W. Baker, and B.D. Freeman, "Polymers and Mixed Matrix Membranes for Gas and Vapor Separation: A Review and Prospective Opportunities," *Macromolecules*, **50**, 7809-7843 (2017).

89. Kirschner, A.Y., C.-C. Chang, S. Kasemset, T. Emrick, B.D. Freeman, "Fouling-Resistant Ultrafiltration Membranes Prepared via Co-Deposition of Dopamine/Zwitterion Composite Coatings," *Journal of Membrane Science*, **541**, 300-311 (2017).

90. Park, H.B., J. Kamcev, L.M. Robeson, M. Elimelech, and B.D. Freeman, "Maximizing the Right Stuff: The Tradeoff Between Membrane Permeability and Selectivity," *Science*, 356(6343), eaab0530 (2017).

91. Kushwaha, A., M.E. Dose, S. Luo, B.D. Freeman, and R. Guo, "Polybenzoxazole (PBO)-based Gas Separation Membranes Thermally Derived from Blends of *Ortho*-functional Polyimide and Polyamide Precursors," *Separation and Purification Technology*, **184**, 384-293 (2017).

92. Kamcev, J., D.R. Paul, G.S. Manning, and B.D. Freeman, "Accounting for Frame of Reference and Thermodynamic Non-idealities When Calculating Salt Diffusion Coefficients in Ion Exchange Membranes," *Journal of Membrane Science*, **537**, 396-206 (2017).

93. Baek, Y., B.D. Freeman, A.L. Zydney, and J. Yoon, "A Facile Surface Modification for Antifouling Reverse Osmosis Membranes using Polydopamine Under UV Irradiation," *Industrial and Engineering Chemistry Research*, **56**, 5756-5760 (2017).

94. Tiwari, R.R., J. Jin, B.D. Freeman, and D.R. Paul, "Physical Aging, CO_2 Sorption and Plasticization in Thin Films of Polymer with Intrinsic Microporosity (PIM-1)," *Journal of Membrane Science*, **537**, 362-371 (2017).

95. Galizia, M., F.M. Benedetti, D.R. Paul and B.D. Freeman, "Monovalent and Divalent Ion Sorption in a Cation Exchange Membrane Based on Cross-linked Poly(*p*-styrene sulfonate-co-divinylbenzene," *Journal of Membrane Science*, **535**, 132-142 (2017).

96. Nebipasagil, A., J. Park, O.R. Lane, B.J. Sundell, S.J. Mecham, B.D. Freeman, J.S. Riffle, J.E. McGrath, "Polyurethanes Containing Poly(arylene ether sulfone) and Poly(ethylene oxide) Segments for Gas Separation Membranes," *Polymer*, **118**, 256-267 (2017).

97. He, Z., S. Kasemset, A.Y. Kirschner, Y.-H. Cheng, D.R. Paul, and B.D. Freeman, "The Effects of Salt Concentration and Foulant Surface Charge on Hydrocarbon Fouling of a Poly(vinylidene fluoride) Microfiltration Membrane," *Water Research*, **117**, 230-241 (2017).

98. Stevens, K.A, Z.P. Smith, K.L. Gleason, M. Galizia, D.R. Paul, and B.D. Freeman, "Influence of Temperature on Gas Solubility in Thermally Rearranged (TR) Polymers," *Journal of Membrane Science*, *533*, 75-83 (2017).

99. Kamcev, J., D.R. Paul, and B.D. Freeman, "Effect of Fixed Charge Group Concentration on Equilibrium Ion Sorption in Ion Exchange Membranes," *Journal of Materials Chemistry A*, **5**, 4638-4650 (2017).

100. Kamcev, J., D.R. Paul, G.S. Manning, and B.D. Freeman, "Predicting Salt Permeability Coefficients in Highly Swollen, Highly Charged Ion Exchange Membranes," *ACS Applied Materials & Interfaces*, **9(4)**, 4044-4056 (2017).

101. He, Z., D.J. Miller, S. Kasemset, D.R. Paul, and B.D. Freeman, "The Effect of Permeate Flux on Membrane Fouling During Microfiltration of Oily Water," *Journal of Membrane Science*, **525**, 25-34 (2017).

102. Robeson, L.M., M.E. Dose, B.D. Freeman, and D.R. Paul, "Analysis of the Transport Properties of Thermally Rearranged (TR) Polymers and Polymers of Intrinsic Microporosity (PIM) Relative to Upper Bound Performance," *Journal of Membrane Science,* **525**, 18-24 (2017).

103. Kasemset, S., L. Wang, Z. He, D.J. Miller, A. Kirschner, B.D. Freeman, and M.M. Sharma, "Influence of Polydopamine Deposition Conditions on Hydraulic Permeability, Sieving Coefficients, Pore Size and Pore Size Distribution for a Polysulfone Ultrafiltration Membrane," *Journal of Membrane Science*, **522**, 100-117 (2017).

104. Miller, D.J., D.R. Dreyer, C.W. Bielawski, D.R. Paul, and B.D. Freeman, "Oberflächenmodifizierung von Wasseraufbereitungsmembranen," *Angewandte Chemie*, **129**, 4734-4788 (2017).

105. Miller, D.J., D.R. Dreyer, C.W. Bielawski, D.R. Paul, and B.D. Freeman, "Surface Modification of Water Purification Membranes," *Angewandte Chemie International Edition*, **56**, 4662-4711 (2017).

106. Galizia, M., K.A. Stevens, Z.P. Smith, D.R. Paul, and B.D. Freeman, "Non-equilibrium Lattice Fluid Modeling of Gas Solubility in HAB-6FDA Polyimide and Its Thermally Rearranged Analogs," *Macromolecules*, **49(22)**, 8768-8779 (2016).

107. Rowlett, J.R., Q. Liu, W. Zhang, J.D. Moon, M.E. Dose, J.S. Riffle, B.D. Freeman, and J.E. McGrath, "Gas Transport Properties and Characterization of UV Crosslinked Poly(phenylene oxide-co-arylene ether ketone) Copolymers," *Journal of Materials Chemistry A*, **4**, 16047-16056 (2016).

108. Galizia, M., D.R. Paul, and B.D. Freeman, "Liquid Methanol Sorption, Diffusion and Permeation in Charged and Uncharged Polymers," *Polymer,* **102**, 281-291 (2016).

109. Ha, Heonjoo, J. Park, S. Ando, C.B. Kim, K. Nagai, B.D. Freeman, and C.J. Ellison, "Gas Permeation and Selectivity of Poly(dimethylsiloxane)/Graphene Oxide Composite Elastomer Membranes," *Journal of Membrane Science,* **518**, 131-140 (2016).

110. Liu, Q., H. Borjigin, D.R. Paul, J.S. Riffle, J.E. McGrath, and B.D. Freeman, "Gas Permeation Properties of Thermally Rearranged (TR) Isomers and Their Aromatic Polyimide Precursors," *Journal of Membrane Science*, **518**, 88-99 (2016).

111. He, Z., D.J. Miller, S. Kasemset, L. Wang, D.R. Paul, and B.D. Freeman, "Fouling Propensity of a Poly(vinylidene fluoride) Microfiltration Membrane to Several Model Oil/Water Emulsions," *Journal of Membrane Science*, **514**, 659-670 (2016).

112. Kamcev, J., and B.D. Freeman, "Charged Polymer Membranes for Environmental/Energy Applications," *Annual Review of Chemical and Biomolecular Engineering*, **7(1)**, 4.1-4.23 (2016).

113. Kasemset, S., Z. He, D.J. Miller, B.D. Freeman, and M.M. Sharma, "Effect of Polydopamine Deposition Conditions on Polysulfone Ultrafiltration Membrane Properties and Threshold Flux during Oil/Water Emulsion Filtration," *Polymer,* **97**, 247-257 (2016).

114. Kamcev, J., and B.D. Freeman, "Cracks Help Membranes to Stay Hydrated," *Nature*, **532**, 445-6 (2016).

115. Liu, Q., M. Galizia, K.L. Gleason, C.A. Scholes, D.R. Paul, and B.D. Freeman, "Influence of Toluene on CO_2 and CH_4 Gas Transport Properties in Thermally Rearranged (TR) Polymers Based on 3,3'-dihydroxy-4,4'-diamino-biphenyl (HAB) and 2,2'-bis-(3,4-dicarboxyphenyl) hexafluoropropane dianhydride (6FDA)," *Journal of Membrane Science,* **514**, 282-293 (2016).

116. Ha, H., J. Park, K. Ha, B.D. Freeman, and C.J. Ellison, "Synthesis and Gas Permeability of Highly Elastic Poly(dimethylsiloxane)/Graphene Oxide Composite Elastomers Using Telechelic Polymers," *Polymer,* **93**, 53-60 (2016).

117. Liu, Q., A.T. Shaver, Y. Chen, G. Miller, D.R. Paul, J.S. Riffle, J.E. McGrath, and B.D. Freeman, "Effect of UV Irradiation and Physical Aging on O_2 and N_2 Transport Properties of Thin Glassy Poly(arylene ether ketone) Copolymer Films Based on Tetramethyl Bisphenol A and 4,4'-Difluorobenzophenone," *Polymer*, **87**, 202-214 (2016).

118. Kamcev, J., M. Galizia, F.M. Benedetti, E.-S. Jang, D.R. Paul, B.D. Freeman, and G.S. Manning, "Partitioning of Mobile Ions Between Ion Exchange Polymers and Aqueous Salt Solutions: Importance of Counter-ion Condensation," *Physical Chemistry Chemical Physics*, **18**, 6021-6031 (2016).

119. Chang, C.-C., Kolewe, K.W., Li, Y., Kosef, I., B.D. Freeman, Carter, K.R., Schiffman, J.D., and Emrick, T.S., "Underwater Superoleophobic Surfaces Prepared From Polymer Zwitterion/Dopamine Composite Coatings," *Advanced Materials Interfaces*, **3(6)**, 1500521 (9 pages) (2016).

120. Sundell, B.J., E.-S. Jang, J.R. Cook, B.D. Freeman, J.S. Riffle, J.E. McGrath, "Cross-Linked Disulfonated Poly(arylene ether sulfone) Telechelic Oligomers. 2. Elevated Transport

Performance with Increasing Hydrophilicity," *Industrial and Engineering Chemistry Research*, **55(5)**, 1419-1426 (2016).

121. Luo, S., K.A. Stevens, J.S. Park, J.D. Moon, Q. Liu, B.D. Freeman, and R. Guo, "Highly CO_2-Selective Gas Separation Membranes Based on Segmented Copolymers of Poly(ethylene oxide) reinforced with Pentiptycene-Containing Polyimide Hard Segments," *ACS Applied Materials & Interfaces*, **8(3)**, 2306-2317 (2016).

122. Liu, Q., D.R. Paul, and B.D. Freeman, "Gas Permeation and Mechanical Properties of Thermally Rearranged (TR) Copolyimides," *Polymer*, **82**, 378-391 (2016).

123. Borjigin, H., Q. Liu, W. Zhang, K. Gaines, J.S. Riffle, D.R. Paul, B.D. Freeman, and J.E. McGrath, "Synthesis and Characterization of Thermally Rearranged (TR) Polybenzoxazoles: Influence of Isomeric Structure on Gas Transport Properties," *Polymer*, **75**, 199-210 (2015).

124. Kamcev, J., D.R. Paul, and B.D. Freeman, "Ion Activity Coefficients in Ion Exchange Polymers: Applicability of Manning's Counter-ion Condensation Theory," *Macromolecules*, **48(21)**, 8011-8024 (2015).

125. Kamcev, J., and B.D. Freeman, "Nanofiltration Membranes," in Encyclopedia of Polymeric Nanomaterials, S. Kobayashi and K. Müllen, Eds., Springer-Verlag, pp. 1342-1349 (2015).

126. Kushwaha, A., M.E. Dose, Z.P. Smith, S. Luo, B.D. Freeman, and R. Guo, "Preparation and Properties of Polybenzoxazole-based Gas Separation Membranes: A Comparative Study Between Thermal Rearrangement (TR) of Poly(hydroxyimide) and Thermal Cyclodehydration of Poly(hydroxyamide)," *Polymer*, **78**, 81-93 (2015).

127. Smith, Z.P., G. Hernández, K.L. Gleason, A. Anand, C.M. Doherty, K. Konstas, C. Alvarez, A.J. Hill, A.E. Lozano, D.R. Paul, and B.D. Freeman, "Effect of Polymer Structure on Gas Transport Properties of Selected Aromatic Polyimides, Polyamides and TR Polymers," *Journal of Membrane Science*, **493**, 766-781 (2015).

128. Su, N.C., Z.P. Smith, B.D. Freeman, and J.J. Urban, "Size-Dependent Permeability Deviations from Maxwell's Model in Hybrid Cross-Linked Poly(ethylene glycol)/silica Nanoparticle Membranes," *Chemistry of Materials*, **27(7)**, 2421-2429 (2015).

129. Borjigin, H, K.A Stevens, R. Liu, J.D. Moon, A.T. Shaver, S. Swinnea, B.D. Freeman, J.S. Riffle, J.E. McGrath, "Synthesis and Characterization of Polybenzimidazoles Derived from Tetraaminodiphenylsulfone for High Temperature Gas Separation Membranes," *Polymer*, **71**, 135-142 (2015).

130. Tiwari, R.R., Z.P. Smith, H. Lin, B.D. Freeman, and D.R. Paul, "Gas Permeation in Thin Films of "High Free-Volume" Glassy Perfluoropolymers: Part II. CO_2 Plasticization and Sorption," *Polymer*, **61**, 1-14 (2015).

131. Robeson, L.R. Q. Liu, B.D. Freeman, and D.R. Paul, "Comparison of Transport Properties of Rubbery and Glassy Polymers and the Relevance to the Upper Bound Relationship," *Journal of Membrane Science*, **476**, 421-431 (2015).

132. Shuangjiang, L., Q. Liu, B. Zhang, J.R. Wiegand, B.D. Freeman, and R. Guo, "Pentiptycene-based Polyimides with Hierarchically Controlled Molecular Cavity Architecture for Efficient Membrane Gas Separation," *Journal of Membrane Science*, **480**, 20-30 (2015).

133. Minelli, M. M.G. DeAngelis, M.G. Baschetti, F. Doghieri, G.C. Sarti, C.P. Ribeiro, and B.D. Freeman, "Equation of State Modeling of the Solubility of CO_2/C_2H_6 Mixtures in Crosslinked Poly(ethylene oxide) (XLPEO)," *Industrial and Engineering Chemistry Research*, **54(3)**, 1142-1152 (2015).

134. Kamcev, J., E.-S. Jang, N. Yan, D.R. Paul, and B.D. Freeman, "Effect of Ambient Carbon Dioxide on Salt Permeability and Sorption Measurements in Ion-Exchange Membranes," *Journal of Membrane Science*, **479**, 55-66 (2015).

135. Gleason, K.L., Z.P. Smith, Q. Liu, D.R. Paul, and B.D. Freeman, "Pure- and Mixed-gas Permeation of CO_2 and CH_4 in Thermally Rearranged Polymers Based on 3,3'-dihydroxy-4,4'-diamino-biphenyl (HAB) and 2,2'-bis-(3,4-dicarboxyphenyl) Hexafluoropropane Dianhydride (6FDA)," *Journal of Membrane Science*, **475**, 204-214 (2015).

136. Galizia, M., Z.P. Smith, G.C. Sarti, B.D. Freeman, and D.R. Paul, "Predictive Calculation of Hydrogen and Helium Solubility in Glassy and Rubbery Polymers," *Journal of Membrane Science*, **475**, 110-121 (2015).

137. Dhoot, S.N., B.D. Freeman, and M. Stewart, "Barrier Polymers," in Encyclopedia of Polymer Science and Technology (Fourth Edition), John Wiley & Sons, 2, 1-65 (2014).

138. Park, J.S., K.L. Gleason, K.E. Gaines, S.J. Mecham, J.E. McGrath, and B.D. Freeman, "Effect of UV Crosslinking on Transport Properties of CO_2 and N_2 Through Poly(imide-siloxane) Segmented Copolymer," *Energy Procedia*, **63**, 210-216 (2014).

139. Smith, Z.P., K. Czenkusch, S. Wi, K.L. Gleason, G. Hernández, C. Doherty, K. Konstas, T. Bastow, C. Alvarez, A. Hill, A. Lozano, D.R. Paul, and B.D. Freeman, "Investigation of the Chemical and Morphological Structure of Thermally Rearranged Polymers," *Polymer*, **55(26)**, 6649-6657 (2014).

140. Tiwari, R.R., Z.P. Smith, H. Lin, B.D. Freeman, and D.R. Paul, "Gas Permeation in Thin Films of "High Free-Volume" Glassy Perfluoropolymers: Part I. Physical Aging," *Polymer*, **55**, 5788-5800 (2014).

141. Scholes, C.A, B.D. Freeman, and S.E. Kentish, "Water Vapor Permeability and Competitive Sorption in Thermally Rearranged (TR) Membranes," *Journal of Membrane Science*, **470**, 132-137 (2014).

142. Kim, H.W., Hee Wook Yoon, Byung Min Yoo, Jae Sung Park, Kristofer L. Gleason, Benny D. Freeman, and Ho Bum Park, "High-performance CO_2-philic Graphene Oxide Membranes in the Wet-conditions," *Chemical Communications*, **50**, 13563-13566 (2014).

143. Sundell, B.J., A.T. Shaver, Q. Liu, A. Nebipasagil, P. Pisipati, S.J. Mecham, J.S. Riffle, B.D. Freeman, and J.E. McGrath, "Synthesis, Oxidation and Crosslinking of Tetramethyl Bisphenol F (TMBPF)-Based Polymers for Oxygen/Nitrogen Gas Separations," *Polymer*, 55, 5623-5634 (2014).

144. Smith, Z.P., and B.D. Freeman, "Graphene Oxide: A New Platform for High Performance Gas and Liquid Separation Membranes, *Angewandte Chemie*, **53**, 10286-10288 (2014).

145. Wiegand, J.R., Z.P. Smith, Q. Liu, C.T. Patterson, B.D. Freeman, R. Guo, "Synthesis and Characterization of Triptycene-Based Polyimides with Tunable High Fractional Free Volume for Gas Separation Membranes," *Journal of Materials Chemistry A*, **2(33)**, 13309-13320 (2014).

146. Smith, Z.P., R.R. Tiwari, M.E. Dose, K.L. Gleason, T.M. Murphy, D.F. Sanders, G. Gunawan, L.M. Robeson, D.R. Paul, and B.D. Freeman, "Influence of Diffusivity and Sorption on Helium and Hydrogen Separations in Hydrocarbon, Silicon, and Fluorocarbon-based Polymers," *Macromolecules*, **47(9)**, 3170-3184 (2014).

147. Arena, J.T., S.S. Manickam, K.K. Reimund, B.D. Freeman, and J.R. McCutcheon, "Solute and Water Transport in Forward Osmosis Using Polydopamine Modified Thin Film Composite Membranes," *Desalination*, **343**, 8-16 (2014).

148. Greenlee, L.F., B.D. Freeman and D.F. Lawler, "Ozonation of Phosphonate Antiscalants Used for Reverse Osmosis Desalination: Parameter Effects on the Extent of Oxidation," *Chemical Engineering Journal*, **244**, 505-513 (2014).

149. Oh, H.J., B.D. Freeman, J.E. McGrath, C.J. Ellison, S. Mecham, and D.R. Paul, "Rheological Studies of Disulfonated Poly(arylene ether sulfone) Plasticized with Poly(ethylene glycol) for Membrane Formation," *Polymer*, **55(6)**, 1574-1583 (2014).

150. Miller, D.J., D.R. Paul, and B.D. Freeman, "An Improved Method for Surface Modification of Porous Water Purification Membranes," *Polymer*, **55(6)**, 1375-1383 (2014).

151. Sanders, D.F., R. Guo, Z.P. Smith, K.A. Stevens, Q. Liu, J.E. McGrath, D.R. Paul, and B.D. Freeman, "Influence of Polyimide Precursor Synthesis Route and *ortho*-Position Functional Group on Thermally Rearranged (TR) Polymer Properties: Pure Gas Permeability and Selectivity," *Journal of Membrane Science*, **463**, 73-81 (2014).

152. Sanders, D.F., R. Guo, Z.P. Smith, Q. Liu, K.A. Stevens, J.E. McGrath, D.R. Paul, and B.D. Freeman, "Influence of Polyimide Precursor Synthesis Route and *ortho*-Position Functional Group on Thermally Rearranged (TR) Polymer Properties: Conversion and Free Volume," *Polymer*, **55**, 1636-1647 (2014).

153. Offord, G.T., S.R. Armstrong, B.D. Freeman, E. Baer, A. Hiltner, and D.R. Paul, "Gas Transport in Coextruded Multilayered Membranes with Alternating Dense Polymeric and Porous Polymeric Layers," *Polymer*, **55**, 1259-1266 (2014).

154. Scholes, C.A., C.P. Ribeiro, S.E. Kentish, and B.D. Freeman, "Thermal Rearranged Poly(benzoxazole)/polyimide Blended Membranes for CO_2 Separation," *Separation and Purification Technology*, **124**, 134-140 (2014).

155. Oh, H.J., B.D. Freeman, J.E. McGrath, C.H. Lee, D.R. Paul, "Thermal Analysis of Disulfonated Poly(arylene ether sulfone) plasticized with poly(ethylene glycol) for membrane applications, *Polymer*, **55**, 235-247 (2014).

156. Miller, D.J., S. Kasemset, D.R. Paul, and B.D. Freeman, "Comparison of Membrane Fouling at Constant Flux and at Constant Transmembrane Pressure," *Journal of Membrane Science*, **454**, 505-515 (2014).

157. Miller, D.J., S. Kasemset, L. Wang, D.R. Paul, and B.D. Freeman, "Constant Flux Crossflow Filtration Evaluation of Surface-Modified Fouling-Resistant Membranes," *Journal of Membrane Science*, **452**, 171-183 (2014).

158. Geise, G.M., C.M. Doherty, A.J. Hill, B.D. Freeman, and D.R. Paul, "Free Volume Characterization of Sulfonated Styrenic Pentablock Copolymers Using Positron Annihilation Lifetime Spectroscopy, *Journal of Membrane Science*, **453**, 425-434 (2014).

159. Armstrong, S.R., G.T. Offord, D.R. Paul, B.D. Freeman, A. Hiltner, and E. Baer, "Co-extruded Polymeric Films for Gas Separation Membranes," *Journal of Applied Polymer Science*, **131(2)**, 39765 (1 of 11) (2014).

160. Geise, G.M., D.R. Paul, and B.D. Freeman, "Fundamental Water and Salt Transport Properties in Polymeric Materials," *Progress in Polymer Science*, **39**, 1-42 (2014).

161. Robeson, L.M., Z.P. Smith, B.D. Freeman and D.R. Paul, "Contributions of Diffusion and Solubility Selectivity to the Upper Bound Analysis for Glassy Gas Separation Membranes," *Journal of Membrane Science*, **453**, 71-83 (2014).

162. Scholes, C.A., C.P. Ribeiro, S.E. Kentish, and B.D. Freeman, "Thermal Rearranged Poly(benzoxazole-co-imide) Membranes for CO_2 Separation," *Journal of Membrane Science*, **450**, 72-80 (2014).

163. Sundell, B.J., K.-S. Lee, A. Nebipasagil, "Cross-Linking Disulfonated Poly(arylene ether sulfone) Telechelic Oligomers. 1. Synthesis, Characterization, and Membrane Preparation, *Industrial and Engineering Chemistry Research*, 53(7), 2583-2593 (2014).

164. Ribeiro, C.P., B.D. Freeman, D.S. Kalika, and S. Kalakkunnath, "Pervaporative Separation of Aromatic/Aliphatic Mixtures with Poly(Siloxane-co-imide) and Poly(Ether-co-Imide) Membranes," *Industrial and Engineering Chemistry Research*, 52, 8906-8916 (2013).

165. Dreyer, D.R., D.J. Miller, B.D. Freeman, D.R. Paul, and C.W. Bielawski, "Perspectives on Poly(dopamine)," *Chemical Science*, **4(10)**, 3796-3802 (2013).

166. Sanders, D.F., Z.P. Smith, R. Guo, L.M. Robeson, J.E. McGrath, D.R. Paul, and B.D. Freeman, "Energy-Efficient Polymeric Gas Separation Membranes for a Sustainable Future: A Review," *Polymer*, **54**, 4729-4761 (2013).

167. Smith, Z.P., R. Tiwari, T.M. Murphy, D.F. Sanders, B.D. Freeman, and D.R. Paul, "Hydrogen Sorption in Polymers for Membrane Applications," *Polymer*, **54**, 3026-3037 (2013).

168. Offord, G.T., S.R. Armstrong, B.D. Freeman, E. Baer, A. Hiltner, and D.R. Paul, "Influence of Processing Strategies on Porosity and Permeability of β Nucleated Isotactic Polypropylene Stretched Films," *Polymer*, **54**, 2796-2807 (2013).

169. Guo, R., D.F. Sanders, Z.P. Smith, B.D. Freeman, D.R. Paul, and J.E. McGrath, "Synthesis and Characterization of Thermally Rearranged (TR) Polymers: Effect of Glass Transition

Temperature of Aromatic Poly(hydroxyimide) Precursors on TR Process and Gas Permeation Properties," *Journal of Materials Chemistry A*, **1(19)**, 6063-6072 (2013).

170. Miller, D.J., X. Huang, H. Li, S. Kasemset, A. Lee, D. Agnihotri, T. Hayes, D.R. Paul, and B.D. Freeman, "Fouling-Resistant Membranes for the Treatment of Flowback Water from Hydraulic Shale Fracturing: a Pilot Study," *Journal of Membrane Science*, **437**, 265-275 (2013).

171. Offord, G.T., S.R. Armstrong, B.D. Freeman, A. Hiltner, J.S. Swinnea, and D.R. Paul, "Porosity Enhancement in β Nucleated Isotactic Polypropylene Stretched Films by Thermal Annealing," *Polymer*, **54**, 2577-2589 (2013).

172. Miller, D.J., D.R. Paul, and B.D. Freeman, "A Crossflow Filtration System for Constant Permeate Flux Membrane Fouling Characterization," *Review of Scientific Instruments*, **84**, 035003-1 - 035003-11 (2013).

173. La, Y.-H., J. Diep, R. Al-Rasheed, D. Miller, L. Krupp, G.M. Geise, A. Vora, B. Davis, M. Nassar, B.D. Freeman, M. McNeil, and G. Dubois, "Enhanced Desalination Performance of Polyamide Bi-layer Membranes Prepared by Sequential Interfacial Polymerization," *Journal of Membrane Science*, **437**, 33-39 (2013).

174. Geise, G.M., C.L. Willis, C.M. Doherty, A.J. Hill, T.J. Bastow, J. Ford, K.I. Winey, B.D. Freeman, and D.R. Paul, "Characterization of Aluminum-Neutralized Sulfonated Styrenic Pentablock Copolymer Films," *Industrial and Engineering Chemistry Research*, **52(3)**, 1056-1068 (2013).

175. Kim, H.W., B.D. McCloskey, T.H. Choi, C. Lee, M.-J. Kim, B.D. Freeman, and H.B. Park, "Oxygen Concentration Control of Dopamine-Induced High Uniformity Surface Coating Chemistry," *ACS Applied Materials and Interfaces*, **5(2)**, 233-238 (2013).

176. Comer, A.C., C.P. Ribeiro, B.D. Freeman, S. Kalakkunnath, and D.S. Kalika, "Dynamic Relaxation Characteristics of Thermally Rearranged Aromatic Polyimides," *Polymer*, **54**, 891-900 (2013).

177. Murphy, T.M., B.D. Freeman and D.R. Paul, "Physical Aging of Polystyrene Films Tracked by Gas Permeability," *Polymer,* **54**, 873-880 (2013).

178. Kasemset, S., A. Lee, D.J. Miller, B.D. Freeman, and M.M. Sharma, "Effect of Polydopamine Deposition Conditions on Fouling Resistance, Physical Properties, and Permeation Properties of Reverse Osmosis Membranes in Oil/Water Separation," *Journal of Membrane Science*, **425-426**, 208-216 (2013).

179. Guo, R., D.F. Sanders, Z.P. Smith, B.D. Freeman, D.R. Paul, and J.E., McGrath, "Synthesis and Characterization of Thermally Rearranged (TR) Polymers: Influence of *Ortho*-positioned Functional Groups of Polyimide Precursors on TR Process and Gas Transport Properties," *Journal of Materials Chemistry A*, **1(2)**, 262-272 (2013).

180. Geise, G.M., B.D. Freeman, and D.R. Paul, "Sodium Chloride Diffusion in Sulfonated Polymers for Membrane Applications," *Journal of Membrane Science*, **427**, 186-196 (2013).

181. Geise, G.M., L.P. Falcon, B.D. Freeman, and D.R. Paul, "Sodium Chloride Sorption in Sulfonated Polymers for Membrane Applications," *Journal of Membrane Science*, **423-424**, 195-208 (2012).

182. Tung, K.K., R.T. Bonnecaze, B.D. Freeman, and D.R. Paul, "Characterization of the Oxygen Scavenging Capacity and Kinetics of SBS Films," *Polymer*, **53(19)**, 4211-4221 (2012).

183. Murphy, T.M., D.S. Langhe, M. Ponting, E. Baer, B.D. Freeman, and D.R. Paul, "Enthalpy Recovery and Structural Relaxation in Layered Glassy Polymer Films," *Polymer*, **53**, 4002-4009 (2012).

184. Smith, Z.P., D.F. Sanders, C.P. Ribeiro, R. Guo, B.D. Freeman, D.R. Paul, J.E. McGrath, and S. Swinnea, "Gas Sorption and Characterization of Thermally Rearranged Polyimides based on 3,3'-dihydroxy-4,4'-diamino-biphenyl (HAB) and 2,2'-bis-(3,4-dicarboxyphenyl) Hexafluoropropane Dianhydride (6FDA)," *Journal of Membrane Science*, **415-416**, 558-567 (2012).

185. Li, H., K.K. Tung, D.R. Paul, B.D. Freeman, M.E. Stewart, and J.C. Jenkins, "Characterization of Oxygen Scavenging Films Based on 1,4-Polybutadiene," *Industrial and Engineering Chemistry Research*, **51(21)**, 7138-7145 (2012).

186. McCloskey, B.D., H.B. Park, H. Ju, B.W. Rowe, D.J. Miller, and B.D. Freeman, "A Bioinspired Fouling-Resistant Surface Modification for Water Purification Membranes," *Journal of Membrane Science,* **413-414**, 82-90 (2012).

187. Araujo, P.A, D.J. Miller, P.B. Correia, M.C.M van Loosdrecht, J.C. Kruithof, B.D. Freeman, D.R. Paul, and J.S. Vrouwenvelder, "Impact of Feed Spacer and Membrane Modification by Hydrophilic, Bactericidal and Biocidal Coating on Biofouling Control," *Desalination*, **295**, 1-10 (2012).

188. Miller, D.J., P. Araújo, P. Correia, M.M. Ramsey, J.C. Kruithof, M.C.M. van Loosdrecht, B.D. Freeman, D.R. Paul, M. Whiteley, and J.S. Vrouwenvelder, "Short-term Adhesion and Long-term Biofouling Testing of Polydopamine and Poly(ethylene glycol) Surface Modifications for Biofouling Control on Membranes and Feed Spacers," *Water Research*, **46(12)**, 3737-3753 (2012).

189. Dreyer, D.R., D.J. Miller, B.D. Freeman, D.R. Paul, and C.W. Bielawski, "Elucidating the Structure of Poly(dopamine)," *Langmuir,* **28**, 6428-6435 (2012).

190. Sanders, D.F., Z.P. Smith, C.P. Ribeiro, R. Guo, J.E. McGrath, D.R. Paul, and B.D. Freeman, "Gas Permeability, Diffusivity, and Free Volume of Thermally Rearranged Polymers based on 3,3'-dihydroxy-4,4'-diamino-biphenyl (HAB) and 2,2'-bis-(3,4-dicarboxyphenyl) hexafluoropropane dianhydride (6FDA)," *Journal of Membrane Science,* **409-410**, 232-241 (2012).

191. Armstrong, S., B. Freeman, A. Hiltner, and E. Baer, "Gas Permeability of Melt-Processed Poly(ether block amide) Copolymers and the Effects of Orientation," *Polymer,* **53(6)**, 1383-1392 (2012).

192. Langhe, D.S., T.M. Murphy, A. Shaver, C. LaPorte, B.D. Freeman, D.R. Paul, and E. Baer, "Structural Relaxation of Polystyrene in Nanolayer Confinement," *Polymer*, **53**, 1925-1931 (2012).

193. Xie, W., G.M. Geise, B.D. Freeman, H.-S. Lee, G. Byun, and J.E. McGrath, "Polyamide Interfacial Composite Membranes Prepared from *m*-phenylene Diamine, Trimesoyl Chloride, and a New Disulfonated Diamine," *Journal of Membrane Science,* **403-404**, 152-161 (2012).

194. La, Y.-H., R. Sooriyakumaran, B. McCloskey, R. Allen, B. Freeman, and R. Al-Rasheed, "Enhancing Water Permeability of Fouling-resistant POSS-PEGM Hydrogels Using 'Addition-extraction' of Sacrificial Additives," *Journal of Membrane Science*, **401-402**, 306-312 (2012).

195. Xie, W., G.M. Geise, B.D. Freeman, C.H. Lee, and J.E. McGrath, "Influence of Processing History on Water and Salt Transport Properties of Disulfonated Polysulfone Random Copolymers," *Polymer,* **53**, 1581-1592 (2012).

196. Lee, C.H., W. Xie, D. Van Houten, J.E. McGrath, B.D. Freeman, J. Spano, S. Wi, C.H. Park, and Y.M. Lee, "Hydrophilic Silica Additives for Disulfonated Poly(arylene ether sulfone) Random Copolymer Membranes," *Journal of Membrane Science*, **392-393**, 157-166 (2012).

197. Lee, C.H., B.D. McCloskey, J. Cook, O. Lane, W. Xie, B.D. Freeman, Y.M. Lee, and J.E. McGrath, "Disulfonated Poly(Arylene Ether Sulfone) Random Copolymer Thin Film Composite Membrane Fabricated Using a Benign Solvent for Reverse Osmosis," *Journal of Membrane Science*, **389**, 363-371 (2012).

198. Ribeiro, C.P., B.D. Freeman, D.S. Kalika, and S. Kalakkunnath, "Aromatic Polyimide and Polybenzoxazole Membranes for the Fractionation of Aromatic/Aliphatic Hydrocarbons by Pervaporation," *Journal of Membrane Science*, **390-391**, 182-193 (2012).

199. Kratz, K., W. Xie, A. Lee, B.D. Freeman, and T. Emrick, "Phosphorylcholine-substituted ROMP Polyolefin Coatings Provide Fouling Resistance to Membrane Materials," *Macromolecular Materials and Engineering*, **296**, 1142-1148 (2011).

200. Murphy, T.M. D.S. Langhe, M. Ponting, E. Baer, B.D. Freeman, and D.R. Paul, "Physical Aging of Layered Glassy Polymer Films via Gas Permeability Tracking," *Polymer*, **52(26)**, 6117-6125 (2011).

201. Geise, G.M., B.D. Freeman, and D.R. Paul, Comparison of the Permeation of $MgCl_2$ versus NaCl in Highly Charged Sulfonated Polymer Membranes," in Modern Applications in Membrane Science and Technology, I. Escobar and B. van der Bruggen, Eds., Chapter 13, pp. 239-245, ACS Symposium Series Volume 1078, American Chemical Society, Washington, DC (2011).

202. Ribeiro, C.P., B.D. Freeman, D.S. Kalika, and S. Kalakkunnath, "Separation of Aromatic/Aliphatic Mixtures by Pervaporation Using ortho-Functionalized Polyimide Membranes," in Modern Applications in Membrane Science and Technology, I. Escobar and B. van der Bruggen, Eds., Chapter 7, pp. 81-105, ACS Symposium Series Volume 1078, American Chemical Society, Washington, DC (2011).

203. Ribeiro, C.P., B.D. Freeman, and D.R. Paul, "Modeling of Multicomponent Mass-Transfer Across Polymer Films Using a Thermodynamically Consistent Formulation of the Maxwell-Stefan Equations in Terms of Volume Fractions," *Polymer*, **52**, 3970-3983 (2011).

204. Xie, W., H. Ju, G. Geise, B. Freeman, J. Mardel, A. Hill, and J. McGrath, "Effect of Free Volume on Water and Salt Transport Properties in Directly Copolymerized Disulfonated Poly(arylene ether sulfone) Random Copolymers," *Macromolecules*, **44**, 4428-4438 (2011).

205. Ribeiro Jr., C.P., B.D. Freeman, and D.R. Paul, "Pure- and Mixed-gas Carbon Dioxide/Ethane Permeability and Diffusivity in a Cross-linked Poly(ethylene oxide) Copolymer," *Journal of Membrane Science*, **377**, 110-123 (2011).

206. Li, H., K.K. Tung, D.R. Paul, and B.D. Freeman, "Effect of Film Thickness on Auto-Oxidation in Cobalt-Catalyzed 1,4-Polybutadiene Films," *Polymer*, **52**, 2772-2783 (2011).

207. Rowe, B.W., B.D. Freeman, and D.R. Paul, "Physical Aging of Membranes for Gas Separations," in Membrane Engineering for the Treatment of Gases: Volume 1, E. Drioli and G. Barbieri, Eds., Royal Society of Chemistry Books, Cambridge, United Kingdom, pp. 58-83 (2011).

208. Lee, C.H., D. Van Houten, O. Lane, J.E. McGrath, J. Hou, L. Madsen, J. Spano, S. Wi, J. Cook, W. Xie, H.J. Oh, G.M. Geise, and B.D. Freeman, "Disulfonated Poly(arylene ether sulfone) Random Copolymer Blends Tuned for Rapid Water Permeation via Cation Complexation with Poly(ethylene glycol)," *Chemistry of Materials*, **23(4)**, 1039-1049 (2011).

209. Li, H., B.D. Freeman, and O.M. Ekiner, "Gas Permeation Properties of Poly(urethane-urea)s Containing Different Polyethers," *Journal of Membrane Science*, **369(1-2)**, 49-58 (2011).

210. Geise, G.M., H.B. Park, A.C. Sagle, B.D. Freeman, and J.E. McGrath, "Water Permeability and Water/Salt Selectivity Tradeoff in Polymers for Desalination," *Journal of Membrane Science,* **369(1-2)**, 130-138 (2011).

211. Lee, C.H., J. Spano, J. McGrath, J. Cook, B. Freeman, and S. Wi, "Solid-State NMR Molecular Dynamics Characterization of A Highly Chlorine-Resistant Disulfonated Poly(arylene ether sulfone) Random Copolymer Blended with Poly(ethylene glycol) Oligomers for Reverse Osmosis Applications," *Journal of Physical Chemistry B*, **115(21)**, 6876-6884 (2011).

212. Arena, J.T., B. McCloskey, B.D. Freeman, and J.R. McCutcheon, "Surface Modification of Thin Film Composite Membrane Support Layers with Polydopamine: Enabling Use of Reverse Osmosis Membranes in Pressure Retarded Osmosis," *Journal of Membrane Science*, **375**, 55-62 (2011).

213. Jiang, Y., F. Willmore, D. Sanders, Z.P. Smith, C.P. Ribeiro, C.M. Doherty, A. Thornton, A.J. Hill, B.D. Freeman, and I.C. Sanchez, "Cavity Size, Sorption and Transport Characteristics of Thermally Rearranged (TR) Polymers," *Polymer*, **52**, 2244-2254 (2011).

214. Xie, W., J. Cook, H.B. Park, B.D. Freeman, C.H. Lee, and J.E. McGrath, "Fundamental Salt and Water Transport Properties in Directly Copolymerized Disulfonated Poly(arylene ether sulfone) Random Copolymers," *Polymer*, **52**, 2032-2043 (2011).

215. La, Y.-H., B.D. McCloskey, R. Sooriyakumaran, A. Vora, B. Freeman, M. Nassar, J. Hedrick, A. Nelson, and R. Allen, "Bifunctional Hydrogel Coatings for Water Purification Membranes: Improved Fouling Resistance and Antimicrobial Activity," *Journal of Membrane Science,* **372**, 285-291 (2011).

216. Greenlee, L.F., F. Testa, D.F. Lawler, B.D. Freeman, and P Moulin, "Effect of Antiscalant Degradation on Salt Precipitation and Solid/Liquid Separation of RO Concentrate," *Journal of Membrane Science,* **366(1-2)**, 48-61 (2011).

217. Reijerkerk, S.R., K. Nijmeijer, C.P. Ribeiro, Jr., B.D. Freeman, M. Wessling, "On the Effects of Plasticization in CO_2/Light Gas Separation Using Polymeric Solubility Selective Membranes," *Journal of Membrane Science,* **367(1-2)**, 33-44 (2011).

218. Van Wagner, E.M., A.C. Sagle, M.M. Sharma, Y.-H. Na, and B.D. Freeman, "Surface Modification of Commercial Polyamide Desalination Membranes using Poly(ethylene glycol) Diglycidyl Ether to Enhance Membrane Fouling Resistance," *Journal of Membrane Science,* **367**, 273-287 (2011).

219. Lin, H., and B.D. Freeman, "Permeation and Diffusion," in *Springer Handbook of Metrology and Testing*, Edited by H. Czichos, T. Saito, and L. Smith, Springer-Verlag, 2nd Edition, Berlin, pp. 426-442 (2011).

220. Rowe, B.W., L.M. Robeson, B.D. Freeman, and D.R. Paul, "Corrigendum to: Influence of Temperature on the Upper Bound: Theoretical Considerations and Comparison with Experimental Results," *Journal of Membrane Science*, **366**, 436 (2011).

221. Freeman, B.D., "Dedication of the Virtual Special Issue of Polymer on Nanocomposites in Celebration of the 70th Birthday of Professor Donald R. Paul Tribute," *Polymer*, **51(22)**, 5005-5006, (2010).

222. Allen, D.T. and B.D. Freeman, "Dedication of This Special Issue of I&EC Research to Professor Donald R. Paul," *Industrial & Engineering Chemistry Research*, **49**(23), 11857-11858 (2010).

223. Geise, G.M., B.D. Freeman, and D.R. Paul, "Characterization of a Sulfonated Pentablock Copolymer for Desalination Applications," *Polymer*, **51**, 5815-5822 (2010).

224. Kusuma, V.A., G. Gunawan, Z.P. Smith, and B.D. Freeman, "Gas Permeability of Cross-Linked Poly(ethylene oxide) Based on Poly(ethylene glycol) Dimethacrylate and a Miscible Siloxane Comonomer," *Polymer*, **51(24)**, 5734-5743 (2010).

225. Rowe, B.W., B.D. Freeman, and D.R. Paul, "Influence of Previous History on Physical Aging in Thin Glassy Polymer Films as Gas Separation Membranes," *Polymer,* **51**, 3784-3792 (2010).

226. McCloskey, B.D., H.B. Park, H. Ju, B.W. Rowe, D.J. Miller, B.J. Chun, K. Kin, and B.D. Freeman, "Influence of Polydopamine Deposition Conditions on Pure Water Flux and Foulant Adhesion Resistance of Reverse Osmosis, Ultrafiltration, and Microfiltration Membranes," *Polymer*, **51**, 3472-3485 (2010).

227. Rowe, B.W., L.M. Robeson, B.D. Freeman, and D.R. Paul, "Influence of Temperature on the Upper Bound: Theoretical Considerations and Comparison with Experimental Results," *Journal of Membrane Science,* **360**, 58-69 (2010).

228. Geise, G.M., H.-S. Lee, D.J. Miller, B.D. Freeman, J.E. McGrath, and D.R. Paul, "Water Purification by Membranes: The Role of Polymer Science," *Journal of Polymer Science: Part B. Polymer Physics,* **48**, 1685-1718 (2010).

229. Ju, H., A.C. Sagle, B.D. Freeman, J.I. Mardel, and A.J. Hill, "Characterization of Sodium Chloride and Water Transport in Crosslinked Poly(ethylene oxide) Hydrogels," *Journal of Membrane Science*, **358**, 131-141 (2010).

230. Kusuma, V.A., B.D. Freeman, S.L. Smith, A.L. Heilman, and D.S. Kalika, "Influence of TRIS-based Co-monomer on Structure and Gas Transport Properties of Crosslinked Poly(Ethylene Oxide)," *Journal of Membrane Science,* **359**, 25-36 (2010).

231. Nye, Y.-H., R. Sooriyakumaran, M. Fujiwara, Y. Terui, K. Yamanaka, B. McClosky, B. Freeman, D. Miller, and R. Allen, "Novel Thin Film Composite Membrane Containing Ionizable Hydrophobes: pH-Dependent Reverse Osmosis Behavior and Improved Chlorine Resistance," *Journal of Materials Chemistry,* **22**, 4615-4620 (2010).

232. Comer, A.C., D.S. Kalika, V.A. Kusuma, and B.D. Freeman, "Glass-Transition and Gas-Transport Characteristics of Polymer Nanocomposites Based on Crosslinked Poly(ethylene oxide)," *Journal of Applied Polymer Science,* **117**, 2395-2405 (2010).

233. Greenlee, L.F., F. Testa, D.F. Lawler, B.D. Freeman, and P. Moulin, "Effect of Antiscalants on Precipitation of an RO Concentrate: Metals Precipitated and Particle Characteristics for Several Water Compositions," *Water Research*, **44(8)**, 2672-2684 (2010).

234. Higuchi, A., M. Tamai, Y.-A. Ko, Y.-O. Tagawa, Y.-H. Wu, B.D. Freeman, J.-T. Bing, Y. Chang, and Q.-D. Ling, "Polymeric Membranes for Chiral Separation of Pharmaceuticals and Chemicals," *Polymer Reviews,* **50(2)**, 113-143 (2010).

235. Greenlee, L.F., F. Testa, D.F. Lawler, B.D. Freeman, and P. Moulin, "The Effect of Antiscalant Addition on Calcium Carbonate Precipitation for a Simplified Synthetic Brackish Water Reverse Osmosis Concentrate," *Water Research*, **44(9)**, 2957-2969 (2010).

236. Ribeiro, C., and B.D. Freeman, "Carbon Dioxide/Ethane Mixed-gas Sorption and Dilation in a Cross-linked Poly(ethylene oxide) Copolymer," *Polymer,* **51**, 1156-1168 (2010).

237. van der Vegt, N., V. Kusuma, and B. Freeman, "Basis of Solubility versus T_c Correlations in Polymeric Gas Separation Membranes," *Macromolecules*, **43**, 1473-1479 (2010).

238. Xie, W., H.B. Park, J. Cook, C. H. Lee, G. Byun, B.D. Freeman, and J.E. McGrath, "Advances in Membrane Materials: Desalination Membranes Based on Directly Copolymerized Disulfonated Poly(Arylene Ether Sulfone) Random Copolymers," *Water Science and Technology,* **61(3)**, 619-624 (2010).

239. Ribeiro, C., and B.D. Freeman, "Solubility and Partial Molar Volume of Carbon Dioxide and Ethane in Crosslinked Poly(ethylene oxide) Copolymer," *Journal of Polymer Science Part B: Polymer Physics,* **48**, 456-468 (2010).

240. Wu, Y.-H., Y.-L Liu, Y. Chang, A. Higuchi, and B.D. Freeman, "Effect of UV Intensity on Structure, Water Sorption, and Transport Properties of Crosslinked N-vinyl-2-pyrrolidone/N,N'-methylenebisacrylamide Films," *Journal of Membrane Science*, **348(1-2)**, 47-55 (2010).

241. McCloskey, B.D., H. Ju, and B.D. Freeman, "Composite Membranes Based on a Selective Chitosan-Poly(ethylene glycol) Hybrid Layer: Synthesis, Characterization, and Performance in Oil-Water Purification," *Industrial and Engineering Chemistry Research,* **49**, 366-373 (2010).

242. Wu, Y.-H., and B.D. Freeman, "Water Uptake, Transport and Structure Characterization in Poly(ethylene glycol) Diacrylate Hydrogels, *Journal of Membrane Science,* **347**, 197-208 (2010).

243. Wang, H., J.K. Keum, A. Hiltner, E. Baer, B. Freeman, A. Rozanski, and A. Galeski, "Confined Crystallization of Polyethylene Oxide in Nanolayer Assemblies," *Science,* **323**, 757-760 (2009).

244. Rowe, B.W., S.J. Pas, A.J. Hill, R. Suzuki, B.D. Freeman, and D.R. Paul, "A Variable Energy Positron Annihilation Lifetime Spectroscopy Study of Physical Aging in Thin Glassy Polymer Films," *Polymer,* **50**, 6149-6156 (2009).

245. Rowe, B.W., B.D. Freeman, and D.R. Paul, "Physical Aging of Ultrathin Glassy Polymer Films Tracked by Gas Permeability," *Polymer*, **50**, 5565-5575 (2009).

246. Van Wagner, E.M., A.C. Sagle, M.M. Sharma, and B.D. Freeman, "Effect of Crossflow Testing Conditions, Including Feed pH and Continuous Feed Filtration, on Commercial Reverse Osmosis Membrane Performance," *Journal of Membrane Science*, **345**, 97-109 (2009).

247. Wu, Y.-H., and B.D. Freeman, "Structure, Water Sorption, and Transport Properties of Crosslinked N-vinyl-2-pyrrolidone/N,N'-methylenebisacrylamide Films," *Journal of Membrane Science*, **344**, 182-189 (2009).

248. Baschetti, M.G., F. Doghieri, B. Freeman, and G.C. Sarti, "Transient and Steady State Effective Diffusivity in High Free Volume Glassy Polymers," *Journal of Membrane Science*, **344**, 144-154 (2009).

249. Robeson, L.M., B.D. Freeman, D.R. Paul, and B.W. Rowe, "An Empirical Correlation of Gas Permeability and Permselectivity in Polymers and Its Theoretical Basis," *Journal of Membrane Science*, **341,** 178-185 (2009).

250. Kusuma, V.A., S. Matteucci, B.D. Freeman, M.K. Danquah, and D.S. Kalika, "Influence of Phenoxy-Terminated Short Chain Pendant Groups on Gas Transport Properties of Crosslinked Poly(ethylene oxide) Copolymers," *Journal of Membrane Science*, **341,** 84-95 (2009).

251. Sagle, A.C., E.M. Van Wagner, H. Ju, B.D. McCloskey, B.D. Freeman, and M.M. Sharma, "PEG-Coated Reverse Osmosis Membranes: Desalination Properties and Fouling Resistance," *Journal of Membrane Science*, **340**, 92-108 (2009).

252. Greenlee, L.F., D.F. Lawler, B.D. Freeman, B. Marrot, and P. Moulin, "Reverse Osmosis Desalination: Water Sources, Technology and Today's Challenges," *Water Research,* **43(9),** 2317-2348 (2009).

253. Hatakeyama, E.S., H. Ju, C.J. Gabriel, J.L. Lohr, J.E. Bara, R.D. Noble, B.D. Freeman, and D.L. Gin, "New Protein-resistant Coatings for Water Filtration Membranes Based on Quaternary Ammonium and Phosphonium Polymers," *Journal of Membrane Science,* **330(1+2)**, 104-116 (2009).

254. Richards, J.J., M.K. Danquah, S. Kalakkunnath, D.S. Kalika, V.A. Kusuma, S.T. Matteucci, B.D. Freeman, "Relation Between Structure and Gas Transport Properties of Polyethylene Oxide Networks Based on Crosslinked Bisphenol A Ethoxylate Diacrylate," *Chemical Engineering Science,* **64**, 4707-4718 (2009).

255. Ferrari, M.C., S. Carranza, R.T. Bonnecaze, K.K. Tung, B.D. Freeman, and D.R. Paul, "Response to Comments in the Letter to the Editor by Solovyov," *Journal of Membrane Science,* **341**, 1 (2009).

256. Ferrari, M.C., S. Carranza, R.T. Bonnecaze, K.K. Tung, B.D. Freeman, and D.R. Paul, "Modeling of Oxygen Scavenging for Improved Barrier Behavior: Blend Films," *Journal of Membrane Science,* **329(1+2)**, 183-192 (2009).

257. Ju, H., B.D. McCloskey, A.C. Sagle, V.A. Kusuma, and B.D. Freeman, "Preparation and Characterization of Crosslinked Poly(ethylene glycol) Diacrylate Hydrogels as Fouling-resistant Membrane Coating Materials," *Journal of Membrane Science*, **330(1+2)**, 180-188 (2009).

258. Kusuma, V.A., B.D. Freeman, M.A. Borns, and D.S. Kalika, "Influence of Chemical Structure of Short Chain Pendant Groups on Gas Transport Properties of Cross-linked Poly(ethylene oxide) copolymers," *Journal of Membrane Science,* **271(1-2)**, 195–207 (2009).

259. Sagle, A.C., H. Ju, B.D. Freeman, and M.M. Sharma, "PEG-Based Hydrogel Membrane Coatings," *Polymer,* **50(3)**, 756–766 (2009).

260. Comer, A.C., D.S. Kalika, B.W. Rowe, B.D. Freeman, and D.R. Paul, "Dynamic Relaxation Characteristics of Matrimid® Polyimide," *Polymer,* **50(3)**, 891–897 (2009).

261. Ribeiro, C. and B.D. Freeman, "Sorption, Dilation, and Partial Molar Volumes of Carbon Dioxide and Ethane in Crosslinked Poly(ethylene oxide)," *Macromolecules,* **41(23)**, 9458–9468 (2008).

262. Li, H., D.K. Ashcraft, B.D. Freeman, M.E. Stewart, M.K. Jank, and T.R. Clark, "Non-invasive Headspace Measurement for Characterizing Oxygen-scavenging in Polymers," *Polymer*, **49(21)**, 4541-4545 (2008).

263. Hu, Y., M. Shiotsuki, F. Sanda, B.D. Freeman, and T. Masuda, "Synthesis and Properties of Indan-Based Polyacetylenes that Feature the Highest Gas Permeability Among All the Existing Polymers, *Macromolecules*, **41(22)**, 8525-8532 (2008).

264. Pethe, V.V., H.P. Wang, A. Hiltner, E. Baer, and B.D. Freeman, "Oxygen and Carbon Dioxide Permeability of EAA/PEO Blends and Microlayers," *Journal of Applied Polymer Science*, **110(3)**, 1411-1419 (2008).

265. Hill, A.J., S.J. Pas, M.R. Hill, and B.D. Freeman, "Characterising the Pore Size Distribution in Nanoporous Materials," *Polymer Preprints* (American Chemical Society, Division of Polymer Chemistry), **49(2)**, 511-512 (2008).

266. Wang, H., V. Pethe, B.D. Freeman, A. Hiltner, and E. Baer, "Polymeric Films for Selective Permeation of CO_2 and O_2," *66th Annual Technical Conference - Society of Plastics Engineers*, 124-128 (2008).

267. Freeman, Benny, "Journal Club," *Nature*, **454(7205)**, 671 (2008).

268. Park, H.B., B.D. Freeman, Z-B. Zhang, M. Sankir, and J.E. McGrath, "Highly Chlorine-Tolerant Polymers for Desalination," *Angewandte Chemie International Edition,* **120**, 6108-6113 (2008) and **47(32)**, 6019-6024 (2008).

269. Kelman, S.D., R.D. Raharjo, C.W. Bielawski, and B.D. Freeman, "The Influence of Crosslinking and Fumed Silica Nanoparticles on Mixed Gas Transport Properties of Poly[1-(trimethylsilyl)-1-propyne]," *Polymer,* **49**, 3029-3041 (2008).

270. Kelman, S.D., B.W. Rowe, C.W. Bielawski, S.J. Pas, A.J. Hill, D.R. Paul, and B.D. Freeman, "Crosslinking Poly[1-(trimethylsilyl)-1-propyne] and its Effect on Physical Stability," *Journal of Membrane Science,* **320**, 123-134 (2008).

271. Kusuma, V.A., H. Lin, B.D. Freeman, M. Jose-Yacaman, S. Kalakkunnath, and D.S. Kalika, "Structure/Property Characteristics of Polar Rubbery Polymeric Membranes for Carbon Dioxide Removal," in Membranes: Manufacturing Utilizing Six Sigma and Applications, edited by N.N. Li, A.G. Fane, W.S.W. Ho, and T. Matsuura, Wiley, New York, pp. 929-953 (2008).

272. Paul, M., H.B. Park, B.D. Freeman, A. Roy, J.E. McGrath, and J.S. Riffle, "Synthesis and Crosslinking of Partially Disulfonated Poly(arylene ether sulfone) Random Copolymers as Candidates for Chlorine Resistant Reverse Osmosis Membranes," *Polymer,* **49(9)**, 2243-2252 (2008).

273. Wang, X.-Y., A.J. Hill, B.D. Freeman, and I.C. Sanchez, "Structural, Sorption, and Transport Characteristics of an Ultrapermeable Polymer," *Journal of Membrane Science,* **314(1-2)**, 15-23 (2008).

274. Matteucci, S., V.A. Kusuma, S.D. Kelman, and B.D. Freeman, "Gas Transport Properties of MgO Filled Poly(1-trimethylsilyl-1-propyne) Nanocomposites," *Polymer,* **49(6)**, 1659-1675 (2008).

275. Matteucci, S., R.D. Raharjo, V.A. Kusuma, S. Swinnea, and B.D. Freeman, "Gas Permeability, Solubility, and Diffusion Coefficients in 1,2-Polybutadiene Containing Magnesium Oxide," *Macromolecules*, **41(6)**, 2144-2156 (2008).

276. Matteucci, S., V.A. Kusuma, S. Swinnea, and B.D. Freeman, "Gas Permeability, Solubility and Diffusivity in 1,2-Polybutadiene Containing Brookite Nanoparticles," *Polymer*, **49(3)**, 757-773 (2008).

277. Ju, H., B.D. McCloskey, A.C. Sagle, Y.-H. Wu, V.A. Kusuma, and B.D. Freeman, "Crosslinked poly(ethylene oxide) Fouling Resistant Coating Materials for Oil/Water Separation," *Journal of Membrane Science*, **307**, 260-267 (2008).

278. Matteucci, S., V.A. Kusuma, D. Sanders, S. Swinnea, and B.D. Freeman, "Gas Transport in TiO_2 Nanoparticle-Filled Poly(1-trimethylsilyl-1-propyne)," *Journal of Membrane Science,* **307**, 196-217 (2008).

279. Kusuma, V.A., G. Offord, and B.D. Freeman, "Optimizing Membranes Structures for CO_2 Separations," *PMSE Preprints*, **98**, 283 (2008).

280. Raharjo, R.D., B.D. Freeman, D.R. Paul, and E.S. Sanders, "Pure and Mixed Gas CH_4 and *n*-C_4H_{10} Permeability and Diffusivity in Poly(1-trimethylsilyl-1-propyne)," *Polymer,* **48(25)**, 7329-7344 (2007).

281. Raharjo, R.D., B.D. Freeman, D.R. Paul, G.C. Sarti, E.S. Sanders, "Pure and Mixed Gas CH_4 and *n*-C_4H_{10} Permeability and Diffusivity in Poly(dimethylsiloxane)," *Journal of Membrane Science*, **306(1-2)**, 75-92 (2007).

282. Borns, M.A., S. Kalakkunnath, D.S. Kalika, V.A. Kusuma, and B.D. Freeman, "Dynamic Relaxation Characteristics of Cross-linked Poly(ethylene oxide) Polymer Networks: Influence of Short Chain Pendant Groups," *Polymer,* **48**, 7316-7328 (2007).

283. Kelman, S.D., S. Matteucci, C.W. Bielawski, and B.D. Freeman, "Crosslinking Poly(1-trimethylsilyl-1-propyne) and Its Effect on Solvent Resistance and Transport Properties," *Polymer*, **48**, 6881-6892 (2007).

284. Park, H.B., C.H. Jung, Y.M. Lee, A.J. Hill, S.J. Pas, S.T. Mudie, E. van Wagner, B.D. Freeman, and D.J. Cookson, "Polymers with Cavities Tuned for Fast, Selective Transport of Small Molecules and Ions," *Science*, **318**, 254-258 (2007).

285. Raharjo, R.D., B.D. Freeman, and E.S. Sanders, "Pure and Mixed Gas CH_4 and *n*-C_4H_{10} Sorption and Dilation in Poly(1-trimethylsilyl-1-propyne)," *Polymer*, **48(20)**, 6097-6114 (2007).

286. Kelman, S., H. Lin, E.S. Sanders, and B.D. Freeman, "CO_2/C_2H_6 Separation Using Solubility Selective Membranes," *Journal of Membrane Science*, **305(1-2)**, 57-68 (2007).

287. Park, H.B., B.D. Freeman, "Gas Separation Properties and Their Applications of Highly Permeable Amorphous Perfluoropolymer Membranes," *Memburein*, **17(2)**, 81-92 (2007).

288. Borns, M.A., S. Kalakkunnath, M.K. Danquah, V.A. Kusuma, B.D. Freeman, and D.S. Kalika, "Relaxation Properties of Poly(ethylene oxide) Copolymer Networks: Influence of Short-Chain Pendant Groups," *PMSE Preprints*, **97**, 840-841 (2007).

289. Sagle, A.C., M.M. Sharma, and B.D. Freeman, "Structure-Property Relationships in PEG-based Hydrogels for Potential Hydrophilic Membrane Coating Materials," *PMSE Preprints*, **97**, 278-279 (2007).

290. Matteucci, S., V.A. Kusuma, and B.D. Freeman, "Nanoparticle-induced Porosity in Rubbery 1,2-Polybutadiene and Its Effect on Gas Permeability," *PMSE Preprints*, **97**, 267-268 (2007).

291. Revanur, R., B. McCloskey, K. Breitenkamp, B.D. Freeman, and T. Emrick, "Reactive Amphiphilic Graft Copolymer Coatings Applied to Poly(vinylidene fluoride) Ultrafiltration Membranes," *Macromolecules*, **40(10)**, 3624-3630 (2007).

292. Matteucci, S., E. Van Wagner, B.D. Freeman, S. Swinnea, T. Sakaguchi, and T. Masuda, "Desilylation of Substituted Polyacetylenes by Nanoparticles," *Macromolecules*, **40(9)**, 3337-3347 (2007).

293. Rowe, B.W., B.D. Freeman, and D.R. Paul, "Effect of Sorbed Water and Temperature on the Optical Properties and Density of Thin Glassy Polymer Films on a Silicon Substrate," *Macromolecules*, **40(8)**, 2806-2813 (2007).

294. Kalakkunnath, S., D.S. Kalika, H. Lin, R.D. Raharjo, and B.D. Freeman, "Molecular Dynamics of Poly(ethylene glycol) and Poly(propylene glycol) Copolymer Networks by Broadband Dielectric Spectroscopy," *Macromolecules*, ***40*(8)**, 2773–2781 (2007).

295. Raharjo, R.D., B.D. Freeman, and E.S. Sanders, "Pure and Mixed Gas CH_4 and *n*-C_4H_{10} Sorption and Dilation in Poly(dimethylsiloxane)," *Journal of Membrane Science*, **292**, 45-61 (2007).

296. Paul, M., A. Roy, H.B. Park, B.D. Freeman, J. Riffle, and J.E. McGrath, "Synthesis and Crosslinking of Poly(arylene ether sulfone) Blend Membranes," *Polymer Preprints* (American Chemical Society, Division of Polymer Chemistry) **48(1)**, 334-335 (2007).

297. Kono, T., Y. Hu, T. Masuda, K. Tanaka, R.D. Priestley, and B.D. Freeman, "Effect of Fumed Silica Nanoparticles on the Gas Permeation Properties of Substituted Polyacetylene Membranes," *Polymer Bulletin*, **58(5-6)**, 995-1003 (2007).

298. Lin, H., B.D. Freeman, S. Kalakkunnath, and D.S. Kalika, "Effect of Copolymer Composition, Temperature, and Carbon Dioxide Fugacity on Pure- and Mixed-Gas Permeability in Poly(ethylene glycol)-Based Materials: Free Volume Interpretation," *Journal of Membrane Science*, **291**, 131-139 (2007).

299. Worrel, L.S., J.A. Morehouse, L.A. Shimko, D.R. Lloyd, D.F. Lawler, and B.D. Freeman, "Enhancement of track-etched membrane performance via stretching," *Separation and Purification Technology*, **53(1),** 71-80 (2007).

300. Kalakkunnath, S., D.S. Kalika, H. Lin, R.D. Raharjo, and B.D. Freeman, "Molecular Relaxation in Crosslinked Poly(ethylene glycol) and Poly(propylene glycol) Diacrylate Networks by Dielectric Spectroscopy," *Polymer*, **48**, 579-589 (2007).

301. Dworak, D.P., H. Lin, B.D. Freeman, and M.D. Soucek, "Gas Permeability Analysis of Photo-cured Cyclohexyl-substituted Polysiloxane films," *Journal of Applied Polymer Science*, **102(3),** 2343-2351 (2006).

302. Park, N.B., C.H. Lee, J.Y. Sohn, Y.M. Lee, B.D. Freeman, and H.J. Kim, "Effect of Crosslinked Chain Length in Sulfonated Polyimide Membranes on Water Sorption, Proton Conduction, and Methanol Permeation Properties," *Journal of Membrane Science*, **285(1-2)**, 432-443 (2006).

303. Lin, H., and B.D. Freeman, "Permeation and Diffusion," in *Handbook of Materials Measurement Methods*, Edited by H. Czichos, T. Saito, and L.E. Smith, Springer, New York, pp. 371-387 (2006).

304. Wang, X.-Y., F.T. Willmore, R.D. Raharjo, X. Wang, B.D. Freeman, A.J. Hill, and I.C. Sanchez, "Molecular Simulations of Physical Aging in Polymer Membrane Materials," *Journal of Physical Chemistry B*, **110(33)**, 16685-16693 (2006).

305. Morehouse, J.A., D.R. Lloyd, B.D. Freeman, D.F. Lawler, K.M. Liechti, and E.B. Becker, "Modeling the Stretching of Microporous Membranes," *Journal of Membrane Science*, **283(1+2)**, 430-439 (2006).

306. Raharjo, R.D., H. Lin, D.F. Sanders, B.D. Freeman, S. Kalakkunnath and D.S. Kalika, "Relation Between Network Structure and Gas Transport in Crosslinked poly (propylene glycol diacrylate)," *Journal of Membrane Science*, **283**, 253-265 (2006).

307. Morehouse, J.A., D.L. Taylor, D.R. Lloyd, D.F. Lawler, B.D. Freeman, and L.S. Worrel, "The Effect of Uni-axial Stretching on the Roughness of Microfiltration Membranes," *Journal of Membrane Science*, **280(1-2)**, 712-719 (2006).

308. Jansen, J.C., M. Macchione, R. Raharjo, B.D. Freeman, and E. Drioli, "Pure and Mixed Gas Transport Properties of Novel Asymmetric Poly(ether ether ketone) Membranes with Different Morphologies," *Desalination*, **199(1-3)**, 461-463 (2006).

309. Wang, X.-Y., R.D. Raharjo, H.J. Lee, Y. Lu, B.D. Freeman, and I.C. Sanchez, "Molecular Simulation and Experimental Study of Substituted Polyacetylenes: Fractional Free Volume,

Cavity Size Distribution and Diffusion Coefficients," *Journal of Physical Chemistry B*, **110**, 12666-12672 (2006).

310. Kalakkunnath, S., D.S. Kalika, H. Lin, and B.D. Freeman, "Viscoelastic Characteristics of UV Polymerized Poly(ethylene glycol) Diacrylate Networks with Varying Extents of Crosslinking," *Journal of Polymer Science: Part B, Polymer Physics*, **44**, 2058-2070 (2006).

311. Matteucci, S., Yu. Yampolskii, B.D. Freeman, I. Pinnau, "Transport of Gases and Vapors in Glassy and Rubbery Polymers," in Materials Science of Membranes for Gas and Vapor Separation, Edited by Y.P. Yampolskii, I. Pinnau, and B.D. Freeman, John Wiley & Sons, Ltd., New York, pp. 1-47 (2006).

312. Merkel, T.C., I. Pinnau, R. Prabhakar, and B.D. Freeman, "Gas and Vapor Transport Properties of Perfluoropolymers," in Materials Science of Membranes for Gas and Vapor Separation, Edited by Y.P. Yampolskii, I. Pinnau, and B.D. Freeman, John Wiley & Sons, Ltd., New York, pp. 251-270 (2006).

313. Lin, H., E. van Wagner, B.D. Freeman, L.G. Toy, and R.P. Gupta, "Plasticization-Enhanced H_2 Purification Using Polymeric Membranes," *Science,* **311(5761)**, 639-642 (2006).

314. Lin, H., E. van Wagner, J.S. Swinnea, B.D. Freeman, S.J. Pas, A.J. Hill, S. Kalakkunnath, and D.S. Kalika, "Transport and Structural Characteristics of Crosslinked Poly(ethylene oxide) Rubbers," *Journal of Membrane Science*, **276(1-2),** 145-161 (2006).

315. Freeman, B.D., "Gas Separations Perspectives," *Maku*, **31(2)**, 86-90 (2006).

316. Lin, H. and B.D. Freeman, "Gas Permeation and Diffusion in Cross-Linked Poly(ethylene glycol diacrylate)," *Macromolecules,* **39(10)**, 3568-3580 (2006).

317. Morehouse, J. A., L.S. Worrel, D.L. Taylor, D.R. Lloyd, B.D. Freeman, and D.F. Lawler, "The Effect of Uni-axial Orientation on Macroporous Membrane Structure," *Journal of Porous Materials*, **13(1)**, 61-72 (2006).

318. Zeng, X., C. Braman, D.L. Gin, B.D. Freeman, "Novel Functional Membrane Coating for Protein Anti-fouling: Design, Synthesis, and Characterization," *PMSE Preprints*, **94**, 543 (2006).

319. Lee, C.H., H.B. Park, Y.S. Chung, Y.M. Lee, and B.D. Freeman, "Water Sorption, Proton Conduction, and Methanol Permeation Properties of Sulfonated Polyimide Membranes Cross-Linked with N,N-Bis(2-hydroxyethyl)-2-aminoethanesulfonic Acid (BES)," *Macromolecules,* **39(2),** 755-764 (2006).

320. Shida, Y., T. Sakaguchi, M. Shiotsuki, F. Sanda, B.D. Freeman, T. Masuda, "Synthesis and Properties of Membranes of Poly(diphenylacetylenes) Having Fluorines and Hydroxyl Groups," *Macromolecules,* **39(2),** 569-574 (2006).

321. Lin, H., E. van Wagner, B.D. Freeman, and I. Roman, "High Performance Polymer Membranes for Natural Gas Sweetening," *Advanced Materials,* **18**, 39-44 (2006).

322. De Angelis, M. G., F. Doghieri, G.C. Sarti, B.D. Freeman, "Modeling Gas Sorption in Amorphous Teflon Through the Non Equilibrium Thermodynamics for Glassy Polymers (NET-GP) Approach," *Desalination*, **193(1-3)**, 82-89 (2006).

323. Ju, H., B. McCloskey, A. Sagle, Y-H. Wu, E. Van Wagner, H.B. Park, B.D. Freeman, L. Shimko, D.F. Lawler, and M.M. Sharma, "Synthesis and Characterization of Surface Coated Ultrafiltration Membranes to Enhance Oil/Water Fouling Resistance," *PMSE Preprints*, **95**, 973-974 (2006).

324. Revanur, R., B. McCloskey, K. Breitenkamp, B.D. Freeman, and T. Emrick, "Amphiphilic Graft Copolymers as Anti-Fouling Coatings for Water Purification Membranes," *PMSE Preprints*, **95**, 972 (2006).

325. Park, H.B., B.D. Freeman, Z.-B. Zhang, G.-Y. Fan, M. Sankir, and J.E. McGrath, "Water and Salt Transport Behavior Through Hydrophilic-Hydrophobic Copolymer Membranes and Their Relations to Reverse Osmosis Membrane Performance," *PMSE Preprints*, **95**, 889-891 (2006).

326. Zhang, Z.-B., G.-Y. Fan, M. Sankir, H.B. Park, B.D. Freeman, and J.E. McGrath, "Synthesis of Di-sulfonated Poly(arylene ether sulfone) Random Copolymers as Novel Candidates for Chlorine-Resistant Reverse Osmosis Membranes," *PMSE Preprints*, **95**, 887-888 (2006).

327. Kelman, S.D., B.D. Freeman, C.W. Bielawski, and A.J. Hill, "Enhancing the Chemical Resistance of High Fractional Free Volume Vapor-Selective Polymers," *PMSE Preprints*, **95**, 810-811 (2006).

328. Wang, X.-Y., B.D. Freeman, I.C. Sanchez, and A.J. Hill, "Effect of Free Volume on Gas Sorption in Polymeric Membranes" *PMSE Preprints*, **95**, 809 (2006).

329. Jung, C.H., H.B. Park, A.J. Hill, B.D. Freeman, Y.M. Lee, "High Performance Polymer Membrane Rendered by Thermal Conversion Process," *PMSE Preprints*, **95**, 617-618 (2006).

330. Raharjo, R.D., B.D. Freeman, E.S. Sanders, "Fundamental Study of Mixture Permeability, Solubility, and Diffusivity in Vapor Selective Polymers," *PMSE Preprints*, **95**, 331-332 (2006).

331. Wang, X.-Y., K.M. Lee, Y. Lu, M.T. Stone, I.C. Sanchez, and B.D. Freeman, "Modeling Transport Properties in High Free Volume Glassy Polymers," in New Polymer Materials (ACS Symposium Series #916), Edited by L.S. Korugic-Karasz, W.J. MacKnight, and E. Martuscelli, American Chemical Society, pp. 187-200, Washington, DC (2005).

332. Sakaguchi, T., M. Shiotsuki, F. Sanda, B.D. Freeman, and T. Masuda, "Synthesis and Properties of F-Containing Poly(diphenylacetylene) Membranes," *Macromolecules,* **38,** 8327-8332 (2005).

333. Wang, X.-Y., P.J. in't Veld, Y. Lu, B.D. Freeman, and I.C. Sanchez, "A Molecular Simulation Study of Cavity Size Distributions and Diffusion in *para* and *meta* Isomers," *Polymer,* **46,** 9155-9161 (2005).

334. Kalakkunnath, S., D.S. Kalika, H. Lin, and B.D. Freeman, "Segmental Relaxation Characteristics of Crosslinked Poly(ethylene oxide) Copolymer Networks," *Macromolecules,* **38***,* 9679-9687 (2005).

335. Kalakkunnath, S., H. Lin, B.D. Freeman, and D.S. Kalika, "Relaxation Characteristics of Crosslinked Poly(ethylene glycol) Diacrylates and Their Relation to Gas Transport Properties," *PMSE Preprints*, **93**, 332-333 (2005).

336. Sagle, A.C., D.L. Gin, M. Sharma, and B.D. Freeman, "Chlorine Resistance Studies on Membranes," *PMSE Preprints*, **93**, 732-733 (2005).

337. Lin, H., T. Kai, B.D. Freeman, S. Kalakkunnath, and D.S. Kalika, "The Effect of Crosslinking on Gas Permeability in Crosslinked Poly(ethylene glycol diacrylate)," *Macromolecules,* **38,** 8381-8393 (2005).

338. Lin, H. and B.D. Freeman, "Gas and Vapor Solubility in Crosslinked Poly(ethylene glycol diacrylate)," *Macromolecules,* **38,** 8394-8407 (2005).

339. Raharjo, R.D., H.J. Lee, B.D. Freeman, T. Sakaguchi, and T. Masuda, "Pure Gas and Vapor Permeation Properties of Poly[1-phenyl-2-[*p*-(trimethylsilyl)phenyl]acetylene] (PTMSDPA) and its desilylated analog, poly[diphenylacetylene] (PDPA)," *Polymer*, **46(17),** 6316-6324 (2005).

340. Prabhakar, R.S., De Angelis, M.G., Sarti, G.C., Freeman, B.D., and M.C. Coughlin, "Gas and Vapor Sorption, Permeation and Diffusion in Poly(tetrafluoroethylene-co-perfluoromethyl vinyl ether)," *Macromolecules*, **38(16),** 7043-7055 (2005).

341. Zhong, J., Lin, G., Wen, W.-Y., Jones, A.A., Kelman, S., Freeman, B.D., "Translation and Rotation of Penetrants in Ultrapermeable Nanocomposite Membrane of Poly(2,2-bis(trifluoromethyl)-4,5-difluoro-1,3-dioxole-co-tetrafluoroethylene) and Fumed Silica," *Macromolecules*, **38(9),** 3754-3764 (2005).

342. Shida, Y., Sakaguchi, T., Shiotsuki, M., Sanda, F., Freeman, B.D., and T. Masuda, "Synthesis and Properties of Poly(diphenylacetylenes) Having Hydroxyl Groups," *Macromolecules*, **38(10),** 4096-4102 (2005).

343. Lin, H., and B.D. Freeman, "Materials Selection Guidelines for Membranes that Remove CO_2 from Gas Mixtures," *Journal of Molecular Structure*, **739(1-3),** 57-74 (2005).

344. Hill, A.J., B.D. Freeman, M. Jaffe, T.C. Merkel, and I. Pinnau, "Tailoring Nanospace," *Journal of Molecular Structure*, **739(1-3*)***, 173-178 (2005).

345. Prabhakar, R.S., T.C. Merkel, B.D. Freeman, T. Imizu, and A. Higuchi, "Sorption and Transport Properties of Propane and Perfluoropropane in Poly(dimethylsiloxane) and Poly(1-trimethylsilyl-1-propyne), *Macromolecules*, **38(5),** 1899-1910 (2005).

346. Prabhakar, R.S., R. Raharjo, L.G. Toy, H. Lin, and B.D. Freeman, "Self-Consistent Model of Concentration and Temperature Dependence of Permeability in Rubbery Polymers," *Industrial & Engineering Chemistry Research*, **44**, 1547-1558 (2005).

347. Worrel, L.S., J.A. Morehouse, D.R. Lloyd, B. Freeman, D.F. Lawler, "Modeling Membrane Behavior During Stretching," Membrane Technology Conference & Exposition, Proceedings, Phoenix, AZ, Mar. 6-9, 2005, 1472-1479 (2005).

348. Shimko, L.A., L.S. Worrel, J.A. Morehouse, D.F. Lawler, D.R. Lloyd, B.D. Freeman, "Membrane Stretching. Impact on Flux and Particle Rejection," Membrane Technology Conference & Exposition, Proceedings, Phoenix, AZ, Mar. 6-9, 2005, 59-63 (2005).

349. Baschetti, M. G., G.C. Sarti, F. Doghieri, F., B. Freeman, "Transient and Steady State Effective Diffusivity in High Free Volume Glassy Polymers," World Congress of Chemical Engineering, 7th, Glasgow, United Kingdom, July 10-14, 2005, 82456/1-82456/10 (2005).

350. De Angelis, M. G., G.C. Sarti, F. Doghieri, and B.D. Freeman, "Alkane-fluoroalkane Interactions in Polymeric Solutions," World Congress of Chemical Engineering, 7th, Glasgow, United Kingdom, July 10-14, 2005 83577/1-83577/10 (2005).

351. Sagle, A., and B. Freeman, "Fundamentals of Membranes for Water Treatment," in The Future of Desalination in Texas: Volume 2, Report Number 363, Texas Water Development Board, Austin, TX, pp. 137-154 (2004).

352. Hill, A.J., S.J. Pas, T.J. Bastow, M.I. Burgar, K. Nagai, L.G. Toy, and B.D. Freeman, "Influence of Methanol Conditioning and Physical Aging on Carbon Spin-Lattice Relaxation Times of Poly(1-trimethylsilyl-1-propyne)," *Journal of Membrane Science*, **243(1-2),** 37-44 (2004).

353. Prabhakar, R.S., B.D. Freeman, and I. Roman, "Gas and Vapor Sorption and Permeation in Poly(2,2,4-trifluoro-5-trifluoromethoxy-1,3-dioxole-co-tetrafluoroethylene)," *Macromolecules,* **37(20),** 7688-7697 (2004).

354. Lin, H., B.D. Freeman, L. Toy, V. Bondar, R. Gupta, S. Gupta, A. Hill, "Reverse-selective Polymeric Membranes for Hydrogen Purification," Polymer Preprints (American Chemical Society, Division of Polymer Chemistry), **45(2),** 22-23 (2004).

355. Lin, H., and B.D. Freeman, "Gas Solubility, Diffusivity, and Permeability in Poly(ethylene oxide)," *Journal of Membrane Science*, **239**, 105-117 (2004).

356. Nagai, K., A. Sugawara, S. Kazama, and B.D. Freeman, "Effects of Physical Aging on Solubility, Diffusivity, and Permeability of Propane and *n*-Butane in Poly(4-methyl-2-pentyne)," *Journal of Polymer Science: Part B, Polymer Physics,* **42**, 2407-2418 (2004).

357. Dhoot, S.N. B.D. Freeman, M.E. Stewart, "Sorption and Transport of Linear and Branched Ketones in Biaxially Oriented Polyethylene Terephthalate," *Polymer*, **45(16),** 5619-5628 (2004).

358. Wang, X.-Y., K.M. Lee, Y. Lu, M.T. Stone, I.C. Sanchez, and B.D. Freeman, "Cavity Size Distributions in High Free Volume Glassy Polymers by Molecular Simulation," *Polymer*, **45(11),** 3907-3912 (2004).

359. Dhoot, S.N. B.D. Freeman, M.E. Stewart, "Sorption and Transport of Linear Esters and Branched Alkanes in Biaxially Oriented Poly(ethylene terephthalate)," *Industrial & Engineering Chemistry Research*, **43(12),** 2966-2976 (2004).

360. Prabhakar, R.S., B.D. Freeman, "Fluoropolymer-hydrocarbon Polymer Composite Membranes for Natural Gas Separation," ACS Symposium Series 876 (Advanced Materials for Membrane Separations), 106-128 (2004).

361. Freeman, B.D.; Pinnau, I., "Gas and Liquid Separations Using Membranes: An Overview," ACS Symposium Series 876 (Advanced Materials for Membrane Separations), 1-23 (2004).

362. Dhoot, S.N., B.D. Freeman, "Kinetic Gravimetric Sorption of Low Volatility Gases and Vapors in Polymers," *Review of Scientific Instruments*, **74(12)**, 5173-5178 (2003).

363. Merkel, T.C., Z. He, I. Pinnau, B.D. Freeman, P. Meakin, A.J. Hill, "Sorption and Transport in Poly(2,2-bis(trifluoromethyl)-4,5-difluoro-1,3-dioxole-co-tetrafluoroethylene) Containing Nanoscale Fumed Silica," *Macromolecules*, **36(22)**, 8406-8414 (2003).

364. Merkel, T.C., Z. He, I. Pinnau, B.D. Freeman, P. Meakin, and A.J. Hill, "Effect of Nanoparticles on Gas Sorption and Transport in Poly(1-trimethylsilyl-1-propyne)," *Macromolecules*, **36(18),** 6844-6855 (2003).

365. Dhoot, S.N., B.D. Freeman, M.E. Stewart "Barrier Polymers" In: Encyclopedia of Polymer Science and Technology, 3rd ed., Volume 5, J. Kroschweitz, editor, John Wiley and Sons, New York, pp. 198-263 (2003).

366. Coker, D.T., R. Prabhakar, and B.D. Freeman, "Gas Separation Using Polymers," *Chemical Engineering Education*, **37(1)**, 60-67 (2003).

367. Ayala, D., A.E. Lozano, J. de Abajo, C. Garcia-Perez, J.G. de la Campa, K.-V. Peinemann, B.D. Freeman, R. Prabhakar, "Gas Separation Properties of Aromatic Polyimides," *Journal of Membrane Science*, **215(1-2)**, 61-73 (2003).

368. Merkel, T. C., B.D. Freeman, R.J. Spontak, Z. He, I. Pinnau, P. Meakin, A.J. Hill, "Sorption, Transport, and Structural Evidence for Enhanced Free Volume in Poly(4-methyl-2-pentyne)/Fumed Silica Nanocomposite Membranes," *Chemistry of Materials,* **15(1)**, 109-123 (2003).

369. DiGiano, F.A., A. Roudman, M.A. Arnold, and B. Freeman, "Novel Block Copolymers as Nanofiltration Materials," *Environmental Engineering and Science,* **19(6),** 497-511 (2002).

370. Alentiev, A. Yu., V.P. Shantarovich, T.C. Merkel, V.I. Bondar, B.D. Freeman, and Yu.P. Yampolskii, "Gas and Vapor Sorption, Permeation, and Diffusion in Glassy Amorphous Teflon AF1600," *Macromolecules*, **35(25),** 9513-9522 (2002).

371. Freeman, B.D., T.C. Merkel, I. Pinnau, Z. He, A.J. Hill, and P. Meakin, "Nanocomposites for Vapor Separation," Proceedings of the American Chemical Society, Polymer Division for the 224th ACS National Meeting, POLY-371 (2002).

372. Prabhakar, R., B.D. Freeman, "Application of Hydrocarbon-fluorocarbon Interactions in Membrane-based Gas Separations," *Desalination*, **144(1-3),** 79-83 (2002).

373. Nagai, K., L.G. Toy, B.D. Freeman, M. Teruguchi, G. Kwak, T. Masuda, and I. Pinnau, "Gas Permeability and *n*-Butane Solubility of Poly(1-trimethylgermyl-1-propyne)," *Journal of Polymer Science: Part B, Polymer Physics*, **40**, 2228-2236 (2002).

374. Merkel, T.C., B.D. Freeman, R.J. Spontak, Z. He, I. Pinnau, P. Meakin and A.J. Hill, "Ultrapermeable, Reverse-Selective Nanocomposite Membranes", *Science,* **296**, 519-522 (2002).

375. De Angelis, M.G., M. Cinti, B.D. Freeman, F. Doghieri, G.C. Sarti, "Sorption and Diffusion of Gases and Vapors in a Perfluorinated Rubber," *PMSE Preprints*, **86**, 133 (2002).

376. Hill, Anita J., P. Meakin, B.D. Freeman, "Modeling the Relationship Between Free Volume and Transport in Polymers: Theory and Experiment," *PMSE Preprints*, **86**, 128-129 (2002).

377. Pinnau, Ingo, B. Freeman, "Polyether-polyamide Block Copolymers: Versatile Materials for Membrane Separations," *PMSE Preprints*, **86**, 108 (2002).

378. Freeman, B., I. Pinnau, "Membranes for Vapor Separations: Recent Advances and Future Directions," *PMSE Preprints*, **86**, 107 (2002).

379. Merkel, T., Toy, L., Coker, D., Gupta, R., Freeman, B.D., Fleming, G., "Removal of Acid Gas Components from Coal-derived Syngas Using Novel, Reverse-selective Membranes," Proceedings – 19th Annual International Pittsburgh Coal Conference 713-723 (2002).

380. Arnold, M.E., K. Nagai, B.D. Freeman, R.J. Spontak, D. Leroux, D.E. Betts, J.M. DeSimone, F.A. DiGiano, C.K. Stebbins, and R.W. Linton, "Microphase-Separated Block Copolymers Comprising Low Surface Energy Fluorinated Blocks and Hydrophilic Blocks: Synthesis and Characterization," *Macromolecules,* **35**, 3697-3707 (2002).

381. De Angelis, M.G., T.C. Merkel, V.I. Bondar, B.D. Freeman, F. Doghieri, and G.C. Sarti, "Gas Sorption and Dilation in Poly(2,2-bistrifluoromethyl-1-4,5-difluoro-1,3-dioxole-co-tetrafluoroethylene): Comparison of Experimental Data with Predictions of the Non-Equilibrium Lattice Fluid Model," *Macromolecules,* **35**, 1276-1288 (2002).

382. Nagai, K., S. Tanaka, Y. Hirata, T. Nakagawa, M. Arnold, B.D. Freeman, D. LeRoux, D.E. Betts, J.M. DeSimone, and F.A. Digiano, "Solubility and Diffusivity of Sodium Chloride in Phase-Separated Block Copolymers of Poly(2-dimethylaminoethyl methacrylate), Poly(1,1'-dihydroperfluorooctyl methacrylate), and Poly(1,1,2,2-tetrahydroperfluorooctyl acrylate)," *Polymer*, **42(25)**, 9941-9948 (2001).

383. Merkel, T.C., R. Gupta, B. Turk, and B.D. Freeman, "Mixed Gas Permeation of Syngas Components in Poly(dimethylsiloxane) and Poly(1-trimethylsilyl-1-propyne) at Elevated Temperatures," *Journal of Membrane Science*, **191(1-2)**, 85-94 (2001).

384. Merkel, T.C., X. Jiang, H. Lin, N.P. Patel, R.J. Spontak, B.D. Freeman, R. Gupta, and B. Turk, "Mixed Gas Permeation Properties of Synthesis Gas Components in Polymers," *PMSE Preprints*, **85**, 100-101 (2001).

385. Merkel, T.C., B.D. Freeman, X. He, A. Morisato, and I. Pinnau, "Nanocomposites for Gas Separations," *PMSE Preprints*, **85**, 301-302 (2001).

386. Prabhakar, R., T.C. Merkel, B.D. Freeman, T. Imizu, A. Higuchi, G.C. Sarti, and F. Doghieri, "Effect of Fluorocarbon-Hydrocarbon Interactions on Solubility and Permeability Properties of Polymers," *PMSE Preprints*, **85**, 253-254 (2001).

387. Lin, H., X. Jiang, N.P. Patel, R.J. Spontak, and B.D. Freeman, "CO_2/H_2 Separation Using Polymers," *PMSE Preprints*, **85**, 146-147 (2001).

388. Arnold, M.E., K. Nagai, B.D. Freeman, R.J. Spontak, D.E. Betts, J.M. DeSimone, and I. Pinnau, "Gas Permeation Properties of Poly(1,1'-dihydroperfluorooctylacrylate) (PFOA), Poly(1,1'-dihydroperfluorooctylmethacrylate) (PFOMA) and Poly(styrene-b-FOA) (PS-b-FOA) Copolymers," *Macromolecules*, **34(16)**, 5611-5619 (2001).

389. Dhoot, S.N., B.D. Freeman, M.E. Stewart, and A.J. Hill, "Sorption and Transport of Linear Alkane Hydrocarbons in Biaxially Oriented Polyethylene Terephthalate," *Journal of Polymer Science: Part B, Polymer Physics,* **39**, 1160-1172 (2001).

390. Dhoot, S.N., B.D. Freeman, M.E. Stewart, and A.J. Hill, "Sorption and Transport of Linear Alkane Hydrocarbons in Biaxially Oriented Polyethylene Terephthalate," Correction, *Journal of Polymer Science: Part B, Polymer Physics*, **39(14),** 1719 (2001).

391. Nagai, K., T. Masuda, T. Nakagawa, B.D. Freeman, and I. Pinnau, "Poly[1-(trimethylsilyl)-1-propyne] and Related Polymers: Synthesis, Properties, and Functions," *Progress in Polymer Science,* **26**, 721-798 (2001).

392. Serad, G.E., B.D. Freeman, M.E. Stewart, and A.J. Hill, "Gas and Vapor Sorption and Diffusion in Poly(ethylene terephthalate)," *Polymer*, **42,** 6929-6943 (2001).

393. Yampolskii, Yu.P., A.P. Korikiv, V.P. Shantarovich, K. Nagai, B.D. Freeman, T. Masuda, M. Teraguchi, and G. Kwak, "Gas Permeability and Free Volume of Highly Branched Substituted Polyacetylenes," *Macromolecules*, **34(6),** 1788-1796 (2001).

394. Sunderrajan, S., B.D. Freeman, C.K. Hall, and I. Pinnau, "Propane and Propylene Sorption in Solid Polymer Electrolytes Based on Poly(ethylene oxide) and Silver Salts," *Journal of Membrane Science*, **182(1-2**), 1-12 (2001).

395. Kwak, G., T. Aoki, L.G. Toy, B.D. Freeman, and T. Masuda, "Synthesis, Characterization, and Oxygen Permeability of Homo- and Copolymers from *p*-[Tris(trimethylsilyl)silyl]-phenylacetylene," *Polymer Bulletin*, **45**, 215-221 (2000).

396. Yampol'skii, Y.P., V.G. Berezkin, T.P. Popova, A.P. Korikov, B.D. Freeman, V.I. Bondar, and T.C. Merkel, "Thermodynamics of Gas and Vapor Sorption by Amorphous Glassy AF Teflons," *Vysokomolekuliarnye soedineniia* (Polymer Science. Series A), **42(6)**, 679-688 (June 2000).

397. DiGiano, F. A., B.D. Freeman, J.M. DeSimone, M. Arnold, K. Nagai, J. Preston, A. Roudman, "Relating Membrane Synthesis to Membrane Performance" Prepr. Ext. Abstr. ACS Natl. Meet., Am. Chem. Soc., Div. Environ. Chem. **40(2),** 293-295 (2000).

398. Bondar, V.I., B.D. Freeman, and I. Pinnau, "Gas Transport Properties of Poly(ether-b-amide) Segmented Block Copolymers," *Journal of Polymer Science: Part B, Polymer Physics*, **38(15)**, 2051-2062 (2000).

399. Higuchi, A., T. Yoshida, T. Imizu, K. Mizoguchi, Z. He, I. Pinnau, K. Nagai, and B.D. Freeman, "Gas Permeation of Fullerene-Dispersed Poly(1-trimethylsilyl-1-propyne) Membranes," *Journal of Polymer Science: Part B, Polymer Physics*, **38**, 1749-1755 (2000).

400. Dixon-Garrett, S.V., B.D. Freeman, and K. Nagai, "Ethylbenzene Solubility, Diffusivity, and Permeability in Poly(dimethylsiloxane)," *Journal of Polymer Science: Part B, Polymer Physics*, **38**, 1461-1473 (2000).

401. Nagai, K., L.G. Toy, B.D. Freeman, M. Teraguchi, T. Masuda, and I. Pinnau, "Gas Permeability and Hydrocarbon Solubility of Poly[1-phenyl-2-[p-(triisopropylsilylphenyl)acetylene]," *Journal of Polymer Science: Part B, Polymer Physics,* **38**, 1474-1484 (2000).

402. Nagai, K., B.D. Freeman, A. Cannon, and H.R. Allcock, "Gas Permeability of Poly(bis-trifluoroethoxy phosphazene) and Adamantane-bearing Polyphosphazene," *Journal of Membrane Science,* **172**, 167-176 (2000).

403. Higuchi, A., T. Agatsuma, S. Uemiya, T. Kojima, K. Mizoguchi, I. Pinnau, K. Nagai, B.D. Freeman, "Preparation and Gas Permeation of Immobilized Fullerene Membrane," *Journal of Applied Polymer Science*, **77**, 529–537 (2000).

404. Nagai, K., B.D. Freeman, and A.J. Hill, "Effect of Physical Aging of Poly(1-trimethylsilyl-1-propyne) Films Synthesized Using $TaCl_5$ and $NbCl_5$ on Gas Permeability, Fractional Free Volume, and Positron Annihilation Lifetime Spectroscopy Parameters," *Journal of Polymer Science: Part B, Polymer Physics,* **38(9)**, 1222-1239 (2000).

405. Dixon-Garrett, S.V., B.D. Freeman, and K. Nagai, "Sorption, Diffusion, and Permeation of Ethylbenzene in Poly(1-trimethylsilyl-1-propyne)," *Journal of Polymer Science: Part B, Polymer Physics,* **38(8)**, 1078-1089 (2000).

406. Toy, L.G., K. Nagai, B.D. Freeman, I. Pinnau, Z. He, T. Masuda, M. Teraguchi, and Yu.P. Yampolskii, "Pure-Gas and Vapor Permeation and Sorption Properties of Poly[1-phenyl-2-[*p*-(trimethylsilyl)phenyl]acetylene] (PTMSDPA)," *Macromolecules*, **33**, 2516-2524 (2000).

407. Merkel, T.C., V.I. Bondar, K. Nagai, B.D. Freeman, and I. Pinnau, "Gas Sorption, Diffusion, and Permeation in Poly(dimethylsiloxane)," *Journal of Polymer Science: Part B, Polymer Physics,* **38**, 415-434 (2000).

408. Merkel, T.C., V. Bondar, K. Nagai, and B.D. Freeman, "Sorption and Transport of Hydrocarbon and Perfluorocarbon Gases in Poly(1-trimethylsilyl-1-propyne)," *Journal of Polymer Science: Part B, Polymer Physics*, **38(2)**, 273-296 (2000).

409. Pinnau, I. and B.D. Freeman, "Membrane Formation and Modification Methods-Overview and Future Developments," in Membrane Formation and Modification, Edited by I. Pinnau and B.D. Freeman, ACS Symposium Series Volume 744, American Chemical Society, Washington, DC, 1-22 (2000).

410. Merkel, T.C., V. Bondar, K. Nagai, B.D. Freeman, and Yu.P. Yampolskii, "Gas Sorption, Diffusion and Permeation in Poly(2,2-bistrifluoro-methyl-4,5-difluoro-1,3-dioxole-*co*-tetrafluoroethylene)," *Macromolecules,* **32(25)**, 8427-8440 (1999).

411. De Angelis, M.G., T.C. Merkel, V.I. Bondar, B.D. Freeman, F. Doghieri, and G.C. Sarti, "Hydrocarbon and Fluorocarbon Solubility and Dilation in Poly(dimethylsiloxane): Comparison of Experimental Data with Predictions of the Sanchez-LaCombe Equation of State," *Journal of Polymer Science: Part B, Polymer Physics,* **37(21)**, 3011-3026 (1999).

412. McDowell, C.C., B.D. Freeman, and G.W. McNeely, "Interval Kinetic Gravimetric Sorption of Acetone in Random Copolymers of Poly(ethylene terephthalate) and Poly(ethylene 2,6-naphthalate)," *Journal of Polymer Science: Part B, Polymer Physics,* **37(21)**, 2973-2984 (1999).

413. DiGiano, F.A., A. Roudman, B. Freeman, M. Arnold, K. Nagai, "Microscale Modeling of Experimental Block Copolymer Behavior to Predict Nanofiltration Performance," Proceedings of the Annual Conference of the American Water Works Association, 13-24 (1999).

414. DiGiano, F.A., B. Freeman, M. Arnold, J. Preston, K. Nagai, A. Roudman, "Membrane characterization and membrane material optimization," Environ. Eng. 1999, Proceedings of the ASCE-CSCE Natl. Conf., 217-226 (1999).

415. Havelka, P.A., K. Nagai, B.D. Freeman, and V.V. Sheares, "Synthesis and Characterization of Poly[[1,1'-biphenyl]-4,4'-diyl[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]]," *Macromolecules*, **32(20)**, 6418-6424 (1999).

416. Sunderrajan, S., B.D. Freeman, and C.K. Hall, "Fourier Transform Infrared Spectroscopic Characterization of Olefin Complexation by Silver Salts in Solution," *Industrial & Engineering Chemistry Research*, **38(10)**, 4051-4059 (1999).

417. Bondar, V.I., B.D. Freeman, and Yu.P. Yampolskii, "Sorption of Gases and Vapors in an Amorphous Glassy Perfluorodioxole Copolymer," *Macromolecules*, **32**, 6163-6171 (1999).

418. McDowell, C.C., J.M. Partin, B.D. Freeman, G.W. McNeely, "Acetone Solubility and Diffusivity in Poly(ethylene terephthalate) Modified with Low Levels of 2,6-naphthalene Dicarboxylic Acid, Isophthalic Acid, and 2,5-bis-(4-carboxyphenyl)-1,3,4-oxadiazole," *Journal of Membrane Science*, **163(1**), 39-49 (1999).

419. Nagai, K., L.G. Toy, B.D. Freeman, M. Teraguchi, T. Masuda, "Influence of Physical Aging and Methanol Conditioning on Gas Permeability and Hydrocarbon Solubility of Poly[1-phenyl-2-[*p*-(triisopropylsilyl)phenyl]acetylene] (PTPSDPA)," *PMSE Preprints*, **81**, 531-532 (1999).

420. Hill, A.J., K. Nagai, B.D. Freeman, "Physical Aging of High Permeability Membrane Polymers," *PMSE Preprints*, **81**, 526-527 (1999).

421. Sheares, V.V., P. Havelka, K. Nagai, B.D. Freeman, "Gas Permeabiltiy Properties of Poly(1,1'-biphenyl]-4,4'-diyl[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]]," *PMSE Preprints*, **81**, 533-534 (1999).

422. Freeman, B.D., C. Nöel, and A.J. Hill, "The Influence of Annealing on Thermal Transitions and Barrier Properties of Nematic Copolyesters," Proceedings of the American Chemical Society Polymer Division, **40(2)**, 478-479 (1999).

423. Bondar, V.I., B.D. Freeman, and I. Pinnau, "Gas Sorption and Characterization of Poly(ether-*b*-amide) Segmented Block Copolymers," *Journal of Polymer Science: Part B, Polymer Physics,* **37**, 2463-2475 (1999).

424. Coker, D.T., T. Allen, B.D. Freeman, and G.K. Fleming, "Nonisothermal Model for Gas Separation Hollow Fiber Membranes," *American Institute for Chemical Engineers Journal*, **45(7)**, 1451-1468 (1999).

425. Singh, A., K. Ghosal, J.G. de la Campa, A.E. Lozano, J. De Abajo and B.D. Freeman, "Gas Separation Properties of Aromatic Polyamides Containing Sulfone and Hexafluoro-isopropylidene Groups," *Polymer*, **40**, 5715-5722 (1999).

426. Nagai, K., B.D. Freeman, T. Watanabe, and T. Nakagawa, "Effects of Physical Aging on Gas Permeability and Molecular Motion in Poly(1-trimethylsilyl-1-propyne," in Polymeric Membranes for Gas and Vapor Separations: Chemistry and Materials Science, Edited by B.D. Freeman and I. Pinnau, ACS Symposium Series Volume 733, American Chemical Society, Washington, DC, pp. 95-101 (1999).

427. Freeman, B.D. and I. Pinnau, "Polymeric Materials for Gas Separations," in Polymeric Membranes for Gas and Vapor Separations: Chemistry and Materials Science, Edited by B.D.

Freeman and I. Pinnau, ACS Symposium Series Volume 733, American Chemical Society, Washington, DC, pp. 1-27 (1999).

428. McDowell, C.C., G. McNeely, and B.D. Freeman, "Acetone Sorption and Uptake Kinetics in Poly(ethylene terephthalate)," *Polymer,* **40**, 3487-3499 (1999).

429. Cantrell, G.R., C.C. McDowell, B.D. Freeman, and C. Noël, "The Influence of Annealing on Thermal Transitions in a Nematic Copolyester," *Journal of Polymer Science: Part B, Polymer Physics*, **37(6)**, 505-522 (1999).

430. Freeman, B.D., "Basis of Permeability/Selectivity Tradeoff Relations in Polymeric Gas Separation Membranes," *Macromolecules*, **32**, 375-380 (1999).

431. Merkel, T., V. Bondar, K. Nagai, B.D. Freeman, "Perfluorocarbon Sorption in Polydimethylsiloxane, Poly(1-trimethylsilyl)-1-propyne), and Random Copolymers of Tetrafluoroethylene and 2,2-bistrifluoromethyl-4,5-difluoro-1,3-dioxole," *Macromolecules*, **32**, 370-374 (1999).

432. Freeman, B.D., and A.J. Hill, "Free Volume and Transport Properties of Barrier and Membrane Polymers," in Structure and Properties of Glassy Polymers, Edited by M.R. Tant and A.J. Hill, ACS Symposium Series Volume 710, American Chemical Society, Washington, DC, pp. 306-325 (1999).

433. Yampolskii, Yu.P., M.V. Motyakin, A.M. Wasserman, T. Masuda, M. Teraguchi, V.S. Khotimskii, B.D. Freeman, "Study of High Permeability Polymers by Means of the Spin Probe Technique," *Polymer*, **40**, 1745-1752 (1999).

434. McDowell, C.C., B.D. Freeman, G.W. McNeely, M.I. Haider, and A.J. Hill, "Synthesis, Physical Characterization, and Acetone Sorption Kinetics in Random Copolymers of Poly(ethylene terephthalate) and Poly(ethylene 2,6-naphthalate)," *Journal of Polymer Science: Part B, Polymer Physics*, **36(16)**, 2981-3000 (1998).

435. Smith, S.W., C.K. Hall, B.D. Freeman, and J.A. McCormick, "Self Diffusion Coefficients and Atomic Mean-Squared Displacements in Entangled Hard Chain Fluids," in Numerical Methods for Polymeric Systems, S.G. Whittington, Ed., Springer-Verlag, New York, 203-215 (1998).

436. Merkel, T., V. Bondar, K. Nagai, M.G. DeAngelis, B. Freeman, and F. Doghieri, "Hydrocarbon and Perfluorocarbon Vapor Sorption in Rubbery and Glassy Hydrocarbon-Based Polymers and Fluoropolymers," *ACS Polymer Preprints*, **39(2)**, 916-917 (1998).

437. Yampolskii, Y.P., A. Y. Alentiev, S.M. Shishatskii, V.P. Shantarovich, B.D. Freeman, and V.I. Bondar, "Fluorine Containing Polymers - Materials for Gas Separating Membranes," *ACS Polymer Preprints*, **39(2)**, 884-885 (1998).

438. Freeman, B.D. "Gas Separations Using Polymers," Chapter 4 in Advances in Chemical and Refining Separations Technology, Edited by C. Payn, The Catalyst Group, Spring House, PA, (1998).

439. Freeman, B., K. Nagai, T. Merkel, V. Bondar, M.G. De Angelis, F. Doghieri, G. Sarti, "Sorption, Diffusion, and Permeation of Perfluorocarbon Vapors and Their Hydrocarbon Analogs in High Free Volume Glassy Polymers," *Polymer Preprints, Japan*, **47(6)**, 1079-1080 (1998).

440. McDowell, C.C., D.T. Coker, and B.D. Freeman, "An Automated Spring Balance for Kinetic Gravimetric Sorption of Gases and Vapors in Polymers," *Review of Scientific Instruments,* **69(6)**, 2510-2513 (June 1998).

441. Coker, D.T., B.D. Freeman, and G.K. Fleming, "Modeling Multicomponent Gas Separation Using Hollow Fiber Membrane Contactors," *American Institute for Chemical Engineers Journal,* **44(6)**, 1289-1302 (June 1998).

442. Huang, S.J., C.J. Durning, and B.D. Freeman, "Modeling Weakly Non-linear Two-stage Sorption Kinetics in Glassy Polymer Films," *Journal of Membrane Science,* **143**, 1-11 (1998).

443. Singh, A., B.D. Freeman, and I. Pinnau, "Pure and Mixed Gas Acetone/Nitrogen Permeation Properties of Poly(dimethylsiloxane) [PDMS]," *Journal of Polymer Science: Part B, Polymer Physics,* **36**, 289-301 (1998).

444. Pinnau, I., C.G. Casillas, A. Morisato, and B.D. Freeman, "Long-Term Permeation Properties of Poly(1-trimethylsilyl-1-propyne) Membranes in Organic Vapor Environment," *Journal of Polymer Science: Part B, Polymer Physics,* **35(10)**, 1483-1490 (1997).

445. Sunderrajan, S., C.K. Hall, and B.D. Freeman, "Chemical Potential Gradient Driven Permeation of Small Molecules through Polymeric Media," *Journal of Chemical Physics,* **107(24)**, 10714-10722 (1997).

446. Bondar, V., A. Singh, and B.D. Freeman, "Gas Sorption and Transport Properties of Poly(tetrafluoroethylele-co-2,2-bistrifluoromethyl-4,5-difluoro-1,3-dioxole)," *AIChE Topical Conference on Separation Science and Technologies*, **2**, 831-837 (1997).

447. Toy, L.G., B.D. Freeman, R.J. Spontak, A. Morisato, and I. Pinnau, "Gas Permeability and Phase Morphology of Poly(1-trimethylsilyl-1-propyne)/Poly(1-phenyl-1-propyne) Blends," *Macromolecules*, **30(16)**, 4766-4769 (1997).

448. Freeman, B.D. and I. Pinnau, "Separation of Gases Using Solubility-Selective Polymers," *Trends in Polymer Science,* **5(5)**, 167-173 (1997).

449. Sunderrajan, S., C.K. Hall, and B.D. Freeman, "Sorption Isotherms for Spherical Penetrants in Facilitating Polymeric Media Using Monte Carlo Simulations," *Molecular Physics,* **92(1)**, 109-116 (1997).

450. Smith, S.W., C.K. Hall, and B.D. Freeman, "Molecular Dynamics for Polymeric Fluids Using Discontinuous Potentials," *Journal of Computational Physics,* **134**, 16-30 (1997).

451. Smith, S.W., C.K. Hall, and B.D. Freeman, "Pressure-Dependent Photon-Correlation Spectroscopic Investigation of Poly(propylene oxide) Near the Glass Transition," *Macromolecules*, **30(7)**, 2052-2057 (1997).

452. Sunderrajan, S., I. Pinnau, and B.D. Freeman, "Sorption and Spectroscopic Analysis of Silver-Olefin Interaction in Polymer Electrolytes," *PMSE Preprints*, **77**, 267-268 (1997).

453. Toy, L.G., B.D. Freeman, A. Morisato, I. Pinnau, T. Masuda, and M. Teraguchi, "Pure-Gas Permeation and Sorption Properties of High-Free-Volume, Vapor-Selective, Glassy Polyacetylenes," *PMSE Preprints*, **77**, 256-257 (1997).

454. Singh, A., V. Bondar, S. Dixon, B.D. Freeman, and A.J. Hill, "Gas Sorption, Transport Properties, and PALS Analysis of Poly(tetrafluoroethylene [TFE]-co-2,2-bistrifluoromethyl-4,5-difluoro-1,3-dioxole [PDD])," *PMSE Preprints*, **77**, 316-317 (1997).

455. Bondar, V.I., B.D. Freeman, and I. Pinnau, "Characterization and Analysis of the Sorption and Pure-Gas Permeation Properties of Polyether-Polyamide Block Copolymers," *PMSE Preprints*, **77**, 311-312 (1997).

456. Nagai, K., B.D. Freeman, T. Watanabe, and T. Nakagawa, "The Effect of Physical Aging on Permeability and Molecular Motion of Poly[1-trimethylsilyl-1-propyne] Membrane," *PMSE Preprints*, **77**, 253-254 (1997).

457. Pinnau, I., L.G. Toy, S. Sunderrajan, and B.D. Freeman, "Solid Polymer Electrolyte Membranes for Olefin/Paraffin Separation," *PMSE Preprints*, **77**, 269-270 (1997).

458. Freeman, B.D., "Transport Properties of Stiff Chain Glassy Polymers," *Polymer Preprints*, ACS Division of Polymer Chemistry, **76**, 423-424 (1997).

459. Smith, S.W., C.K. Hall, and B.D. Freeman, "Reply to Comment on Molecular Dynamics Study of Entangled Hard Chain Fluids," *Physical Review Letters*, **76**, 4449 (1996).

460. Pinnau, I., C.G. Casillas, A. Morisato, and B.D. Freeman, "Hydrocarbon/Hydrogen Mixed-Gas Permeation in Poly(1-trimethylsilyl-1-propyne) [PTMSP], poly(1-phenyl-1-propyne) [PPP] and PTMSP/PPP Blends," *Journal of Polymer Science: Part B, Polymer Physics*, **34(15)**, 2613-2621 (1996).

461. Morisato, A., B.D. Freeman, C.G. Casillas, and I. Pinnau, "Pure Hydrocarbon Sorption Properties of Poly(1-trimethylsilyl-1-propyne) [PTMSP], poly(1-phenyl-1-propyne) [PPP] and PTMSP/PPP Blends," *Journal of Polymer Science: Part B, Polymer Physics*, **34**, 1925-1934 (1996).

462. Ghosal, K., R.T. Chern, B.D. Freeman, W.H. Daly, and I.I. Negulescu, "The Effect of Basic Substituents on Gas Sorption and Permeation in Polysulfone," *Macromolecules,* **29(12)** 4360-4369 (1996).

463. Shen, H.C., C. McDowell, S.S. Sankar, B.D. Freeman, R.J. Kumpf, D.A. Wicks, C.W. Lantmann, and C. Noël, "Synthesis and Thermal Transitions of a New Soluble Main Chain Nematic Liquid Crystalline Polymer," *Journal of Polymer Science: Part B, Polymer Physics*, **34**, 1347-1361 (1996).

464. Sunderrajan, S., C.K. Hall, and B.D. Freeman, "Estimation of Mutual Diffusion Coefficients in Polymer/Penetrant Systems Using Nonequilibrium Molecular Dynamics Simulations," *Journal of Chemical Physics,* **105(4)**, 1621-1632 (1996).

465. Morisato, A., H.-C. Shen, S. Sankar, B.D. Freeman, C.G. Casillas, and I. Pinnau, "Polymer Characterization and Gas Permeability of Poly(1-trimethylsilyl-1-propyne) [PTMSP], poly(1-phenyl-1-propyne) [PPP] and PTMSP/PPP Blends," *Journal of Polymer Science: Part B, Polymer Physics*, **34**, 2209-2222 (1996).

466. Freeman, B.D., "Calculated Performance of Hollow Fiber Modules for H_2/CH_4 Gas Separation Using Aromatic Polyamide Membranes," The 1996 *Membrane Technology Reviews*, edited by D. Mulloy, Business Communications Co., Norwalk, CT, 129-140 (1996).

467. Smith, S.W., C.K. Hall, and B.D. Freeman, "Molecular Dynamics Study of Entangled Hard-Chain Fluids," *Journal of Chemical Physics,* **104(18)**, 5616-5637 (1996).

468. Shen, H.C., C.C. McDowell, B.D. Freeman, and C. Noël, "Thermal Transitions and Structure Evolution in PICT, a Soluble Nematic LCP Exhibiting a Kinetically Trapped, Disordered Microstructure," *Polymer Preprints*, ACS Division of Polymer Chemistry, **37(1)** 90-91(1996).

469. Hill, A.J., B.D. Freeman, C.C. McDowell, and M. Jaffe, "The Role of Free Volume in the Room Temperature Transport Properties of Aromatic Copolyesters: the As-Cast Isotropic State as Compared to the Annealed Nematic State," Proc. of IMSTEC '96, Vol. 2, A. G. Fane Ed., UNESCO Centre for Membrane Science and Tech: Sydney, 38-40 (1996).

470. Smith, S.W., B.D. Freeman, C.K. Hall, and R. Rautenbach, "Analytical Gas-Permeation Models for Binary Gas Mixture Separation Using Membrane Modules," *Journal of Membrane Science*, **118**, 289-294 (1996).

471. Smith, S.W., C.K. Hall, and B.D. Freeman, "Large-Scale Molecular Dynamics Study of Entangled Hard-Chain Fluids," *Physical Review Letters,* **75(7)**, 1316-1319 (1995).

472. Morisato, A., K. Ghosal, B.D. Freeman, R.T. Chern, J.C. Alvarez, J.G. de la Campa, A.E. Lozano and J. de Abajo, "Gas Separation Properties of Aromatic Polyamides Containing Hexafluoroisopropylidine Groups," *Journal of Membrane Science*, **104(3)**, 231-241 (1995).

473. Freeman, B.D., "Osmosis," in *Encyclopedia of Applied Polymer Physics*, **13**, 59-71 (1995).

474. Ghosal, K., B.D. Freeman, R.T. Chern, J.C. Alvarez, J.G. de la Campa, A.E. Lozano, and J. de Abajo, "Gas Separation Properties of Aromatic Polyamides with Sulfone Groups," *Polymer*, **36(4)**, 793-800 (1995).

475. Ghosal, K., R.T. Chern, and B.D. Freeman, "The Effect of Aryl Nitration on Gas Sorption and Permeation in Polysulfone," *Journal of Polymer Science: Part B, Polymer Physics*, **33**, 657-666 (1995).

476. Smith, S.W., C.K. Hall, and B.D. Freeman, "Molecular Dynamics Study of Transport Coefficients for Hard-chain Fluids," *Journal of Chemical Physics*, **102(2)**, 1057-1073 (1995).

477. Freeman, B., M. Arnold, J.M. DeSimone, R. Linton, D. Betts, and C. Kassis, "Gas Transport and Surface Segregation of Polymer Membranes Based on Poly(1,1'-dihydroperfluorooctylacrylate)," *MARIENV'95 Conference Proceedings* (1995).

478. Freeman, B.D., A. Singh, and A. Morisato, I. Pinnau and C.G. Casillas, "Novel Polymer Membranes for Recovery of VOCs and Fluorocarbons from Air Streams," *MARIENV'95 Conference Proceedings* (1995).

479. Ghosal, K. and B.D. Freeman, "Gas Separations Using Polymeric Membranes: An Overview," *Polymers for Advanced Technologies,* **5(11)**, 673-697 (1994).

480. Morisato, A., N.R. Miranda, J.T. Willits, G.R. Cantrell, B.D. Freeman, H.B. Hopfenberg, S. Makhija, I. Haider, and M. Jaffe, "The Sensitivity of Small Molecule Sorption Properties to Morphology in Glassy Liquid Crystalline Polymers," in Crystallization and Related Phenomena

in Amorphous Materials: Ceramics, Metals, Polymers, and Semiconductors, edited by M. Libera, P. Cebe, T. Haynes, and J. Dickinson, Mat. Res. Soc. Symp. Proc. Vol. 321, 81-86 (1994).

481. Cantrell, G.R., B.D. Freeman, H.B. Hopfenberg, S. Makhija, I. Haider, and M. Jaffe, "The Influence of Thermal Annealing on Organic Vapor Sorption and Transport in a Nematogenic Copolyester," in *Liquid Crystalline Polymers*, C. Carfagna, Editor, Pergamon Press, New York, 233-251 (1994).

482. Miranda, N.R., B.D. Freeman, and H.B. Hopfenberg, "Organic Vapor Sorption and Transport in a Thermotropic Liquid Crystalline Polyester," *Journal of Membrane Science*, **94(1-3)**, 67-83 (1994).

483. Freeman, B., M. Arnold, J. DeSimone, R. Linton, D. Betts, C. Kassis, Z. Guan, J. Steehler, "Very Low Surface Energy Heterophase Polymeric Materials for Membrane Separations," *Proceedings of the US-Japan Technical Workshop on Shipboard Wastes Treatment Technology*, 2-20 to 2-25 (1994).

484. Freeman, B.D., "Editorial: Gas Separations Using Polymeric Membranes," *Polymers for Advanced Technologies,* **5(11)**, 671-672 (1994).

485. Ghosal, K., Morisato, A., Freeman, B.D., Chern, R.T., Alvarez, J.C., de la Campa, J.G., and de Abajo, J., "Synthesis and Gas Separation Properties of a Family of New Aromatic Polyamides for Petrochemical Applications," *Polymer Preprints*, ACS Division of Polymer Chemistry, **35(1)**, 712-713 (1994).

486. Hariharan, R., R.G. Carbonell, B.D. Freeman, and G.C. Sarti, "Equation of State Predictions of Sorption Isotherms in Polymeric Materials," *Journal of Applied Polymer Science,* **50**, 1781-1795 (1993).

487. Morisato, A., B.D. Freeman, H.B. Hopfenberg, G. Costa and S. Russo, "The Influence of Chain Configuration and, in Turn, Chain Packing on the Sorption and Transport Properties of Poly(*tert*-butyl acetylene)," *Journal of Applied Polymer Science*, **49**, 2065-2074 (1993).

488. Ghosal, K., R.T. Chern, and B.D. Freeman, "Gas Permeability of Radel A Polysulfone," *Journal of Polymer Science: Part B, Polymer Physics*, **31**, 891-893 (1993).

489. Hariharan, R., R.G. Carbonell, B.D. Freeman, and G.C. Sarti, "Equation of State Predictions of Sorption Isotherms in Polymeric Materials," *Fluid Phase Equilibria*, **83**, 407-414 (1993).

490. Ghosal, K., R.T. Chern, and B.D. Freeman, "The Effect of Aryl Nitration on Gas Sorption and Permeation in Polysulfone," *Advances in Filtration and Separation Technology*, Leung, W.W.F., Ed., **7**, 372-375 (1993).

491. Cantrell, G.R., Freeman, B.D., and Hopfenberg, H.B., "The Effect of Thermal Annealing on the Sorption and Transport Behavior of Liquid Crystalline Polymeric Barrier Materials," *Polymer Preprints*, ACS Division of Polymer Chemistry, **34(1)**, 894-895 (1993).

492. Roos, F.H., W.H. Daly, I.I. Negulescu, M.N. Aniano-llao, K. Ghosal, and B.D. Freeman, "Synthesis, Characterization, and Potential Applications of Some Substituted Aromatic Poly(ether sulfone)s," *PMSE Preprints*, **69**, 556-557 (1993).

493. Freeman, B.D., "Mutual Diffusion in Polymers," *Comprehensive Polymer Science, First Supplement*, Aggarwal, S.L. and S. Russo, Editors, Pergamon Press, New York, pp. 167-198, (1992).

494. Bokobza, L., L. Monnerie, and B.D. Freeman, "Investigation of Polymer Dynamics Through the Intramolecular Excimer Formation of Small Probes: Temperature and Pressure Effects," *Polymer Preprints*, ACS Division of Polymer Chemistry, **33(1)**, 816-817 (1992).

495. Costa, G., Gattiglia, E., Grosso, A., Russo, S., Freeman, B.D., and Hopfenberg, H.B., "Poli(*t*-butilacetilene): Effetto Delle Condizioni di Sintesi Sulla Struttura et Sulle Proprieta' di Trasporto," Proceedings of the AIM (Italian Macromolecular Association) (1992).

496. Ghosal, K., R.T. Chern, B.D. Freeman, W.H. Daly, I.I. Negulescu, and R. Savariar, "The Effect of Aryl Amination and Nitration on Gas Sorption, Diffusion, and Permeation in Polysulfones," AIChE Meeting, Miami Beach, FL, November 1-6, 1992, *First Separations Division Topical Conference on Separations Technologies: New Developments and Opportunities*, 903-908 (1992).

497. Freeman, B.D., L. Bokobza, P. Sergot, L. Monnerie, and F.C. DeSchryver, "Using the Emission Properties of an Intramolecular Excimer-Forming Probe Molecule to Determine the Effect of Hydrostatic Pressure on Local Polymer Dynamics," *Journal of Luminescence*, **48&49**, 259-264 (1991).

498. Miranda, N.R., B.D. Freeman, and H.B. Hopfenberg, "The Relative Contribution of Adsorption to the Overall Sorption and Transport of Small Molecules in Amber," *Journal of Membrane Science*, **60**, 147-155 (1991).

499. Miranda, A. Morisato, B.D. Freeman, H.B. Hopfenberg, G. Costa and S. Russo, "The Effect of Higher Order Molecular Structure Upon the Sorption and Transport of Small Molecules in Stiff-Chain Glassy Polymers," *Polymer Preprints*, ACS Division of Polymer Chemistry, **32(3)**, 382-383 (1991).

500. Freeman, B.D., L. Bokobza, P. Sergot, L. Monnerie, and F.C. De Schryver, "The Effect of Hydrostatic Pressure on Local Polymer Dynamics in Poly(propylene oxide)," *Macromolecules*, **23(9)**, 2566-2573 (1990).

501. Freeman, B.D., L. Bokobza, and L. Monnerie, "The Effect of Hydrostatic Pressure on Local Polymer Dynamics in Polyisoprene," *Polymer*, **31**, 1045-1050 (1990).

502. Freeman, B.D., D.S. Soane, and M.M. Denn, "Effect of Hydrostatic Pressure on Polystyrene Diffusivity in Toluene," *Macromolecules*, **23**, 245-251 (1990).

503. Freeman, B.D., W. Provine, G.H. Dow, and M.M. Denn, "Design of a Slurry Pipeline," CAChE Corporation program library (1987).

504. Freeman, B.D., M.M. Denn, R. Keunings, G. Molau, and J. Ramos, "Profile Development in Drawn Hollow Tubes," *Journal of Polymer Engineering*, **6**, 171-186 (1986).

505. Devereux, B.M., B.D. Freeman, D.S. Soong, and M.M. Denn, "Simulation of Melt Spinning with Kinetic Network Models," *Proceedings of SPE/ANTEC'85*, 669-671 (1985).

PATENTS:

Issued Patents:

1. J.S. Riffle, O.R. Lane, A. Daryaei, S. Roy-Choudhury, B.D. Freeman, E.S. Jang, G.S. Narang, J.J. Lesko, and T. Schumacher, "Sulfonated Poly(arylene ether) Membranes with High Monovalent Salt Rejection Even in the Presence of Mixed Salt Feeds that Contain Multivalent Salts," U.S. Patent Application US 2020/0362107 A1, Published 19 November 2020, allowed October 2022.

2. J.F. Brennecke, B.D. Freeman, C.M. Sanchez, "Systems and Methods for Separation of Olefins From Mixtures that Contain Reducing Agents," U.S. Patent 11,420,916, issued August 23, 2022.

3. H. Wang, H. Zhang, X. Li, J. Lu, B. Freeman, and A.J. Hill, "Metal Organic Framework Membranes," Canadian Patent Application Number 3,08,5642, issued 20 September 2022.

4. H. Wang, H. Zhang, X. Li, J. Lu, B. Freeman, and A.J. Hill, "Metal Organic Framework Membranes," U.S. Provisional Application Number 16/771,324, allowed 8 June 2022.

5. H. Wang, H. Zhang, X. Li, J. Lu, B. Freeman, and A.J. Hill, "Metal Organic Framework Membranes," Australian Patent Number 2018384084, accepted November 30, 2021, granted March 24, 2022.

6. J.E. McGrath, J.S. Riffle, and B.D. Freeman, "Polybenzimidazoles and Methods of Making and Using Thereof," U.S. Patent 10,188,992, issued January 29, 2019.

7. E. Baer, S. Armstrong, B.D. Freeman, D.R. Paul, and G. Offord, "Gas Separation Membrane," U.S. Patent 9,724,900, issued August 8, 2017.

8. J.E. McGrath, Y. Chen, R. Guo, and B.D. Freeman, "Crosslinked Polymer Compositions, Gas Separation Membranes of Such Crosslinked Polymer Compositions, Methods of Making Such Membranes, and Methods of Separating Gases Using Such Membranes," U.S. Patent 9,533,254, issued January 3, 2017.

9. J.E. McGrath, Y. Chen, R. Guo, and B.D. Freeman, "Crosslinked Polymer Compositions, Gas Separation Membranes of Such Crosslinked Polymer Compositions, Methods of Making Such Membranes, and Methods of Separating Gases Using Such Membranes," Russian Patent Number 2682877, issued March 22, 2019.

10. J.E. McGrath, Y. Chen, R. Guo, and B.D. Freeman, "Crosslinked Polymer Compositions, Gas Separation Membranes of Such Crosslinked Polymer Compositions, Methods of Making Such Membranes, and Methods of Separating Gases Using Such Membranes," Chinese (PRC) Patent Number ZL 2014800601016, issued May 3, 2019.

11. E. Baer, S. Armstrong, B.D. Freeman, D.R. Paul, and G. Offord, "Gas Separation Membrane," U.S. Patent 8,911,540, issued December 16, 2014.

12. T.S. Emrick, K. Breitenkamp, R. Revanur, B.D. Freeman, and B. McCloskey, "Process of Forming Crosslinked Copolymer Film, Crosslinked Copolymer Film Formed Thereby, and Water Purification Membrane," U.S. Patent 8,163,814 B2, issued April 24, 2012.

13. J.E. McGrath, B.D. Freeman, and H.B. Park, "Chlorine Resistant Reverse Osmosis Membranes," U.S. Patent 8,028,842 B2, issued October 4, 2011.

14. B.D. Freeman, H.B. Park, and B.D. McCloskey, "Water Purification Membranes with Improved Fouling Resistance," U.S. Patent 8,017,050 B2, issued September 13, 2011.

15. B.D. Freeman, H.B. Park, and B.D. McCloskey, "Water Purification Membranes with Improved Fouling Resistance," Australian Patent Number 2009268532, issued April 26, 2013.

16. B.D. Freeman, H.B. Park, and B.D. McCloskey, "Water Purification Membranes with Improved Fouling Resistance," Canadian Patent Number 2,767,761, issued March 8, 2016.

17. B.D. Freeman, H.B. Park, and B.D. McCloskey, "Water Purification Membranes with Improved Fouling Resistance," Israeli Patent Number 210488, issued September 1, 2016.

18. B.D. Freeman, H.B. Park, and B.D. McCloskey, "Water Purification Membranes with Improved Fouling Resistance," Japanese Patent Number 5463355, issued January 24, 2014.

19. B.D. Freeman, H.B. Park, and B.D. McCloskey, "Water Purification Membranes with Improved Fouling Resistance," Mexican Patent Number 304746, issued October 31, 2012.

20. B.D. Freeman, H.B. Park, and B.D. McCloskey, "Water Purification Membranes with Improved Fouling Resistance," Republic of Korea Patent Number 10-1310054, issued September 12, 2013.

21. B.D. Freeman, H.B. Park, and B.D. McCloskey, "Water Purification Membranes with Improved Fouling Resistance," South Africa Patent Number 2011/01059, issued October 26, 2011.

22. B.D. Freeman, H.B. Park, and B.D. McCloskey, "Water Purification Membranes with Improved Fouling Resistance," United Arab Emirates Patent allowed.

23. B.D. Freeman, S. Matteucci, and H. Lin, "Metal Oxide Nanoparticle Filled Polymers," U.S. Patent 7,510,595 B2, issued March 31, 2009.

Patent Applications:

1. E. Pas, A. Singh, T.G. Mason, B.D. Freeman, B.M. Teo, and Z. Lu, method of Producing a Poly(catecholamine) coating," U.S. Provisional Patent Application 63/215,598, Filed 28 June 2021.

2. C.J. Brinker, J.F. Brennecke, B. Freeman, and S. Park, "High-Pressure Operable Supported Ionic Liquid Membrane," U.S. Patent Application 62/894,324, Filed 30 August 2019.

3. B. Freeman, K. Reimund, and T.J. Dilenschneider, "Methods of Fabricating Polymer Films and Membranes," U.S. Patent Application 62/892,440, Filed 27 August 2019 (also WO 2021/041514 A1).

4. B. Freeman, T.J. Dilenschneider, and K. Reimund, "Mixed Matrix Membranes and Methods of Making and Use Thereof," U.S. Patent Application 62/892,439, Filed 27 August 2019 (also WO 2021/04512 A1).

5. B.D. Freeman, D.R. Paul, and J.D. Moon, "Thermally-Rearranged Polymer Blends for Gas Separation Membranes," PCT Application Number PCT/US2019/025393, Filed 2 April 2019.

6. B.D. Freeman, D.R. Paul, and J.D. Moon, "Thermally-Rearranged Polymer Blends for Gas Separation Membranes," U.S. Patent Application US 2021/0095122 A1, Published 1 April 2021.

7. J.F. Brennecke, B.D. Freeman, and C.M. Sanchez, "Systems and Methods for Separation of Olefins from Mixtures that Contain Reducing Agents," PCT Application Number PCT/US19/036277, Filed June 10, 2019.

8. J.S. Riffle, O.R. Lane, A. Daryaei, S. Roy-Choudhury, B.D. Freeman, E.S. Jang, G.S. Narang, J.J. Lesko, and T. Schumacher, "Sulfonated Poly(arylene ether) Membranes with High Monovalent Salt Rejection Even in the Presence of Mixed Salt Feeds that Contain Multivalent Salts," WO 2019/157407 A1, Published 15 August 2019.

9. B.D. Freeman, D.R. Paul, and J.D. Moon, "Thermally-Rearranged Polymer Blends for Gas Separation Membranes," PCT Application Number PCT/US19/025393, Filed February 4, 2019.

10. H. Wang, H. Zhang, X. Li, J. Lu, A.J. Hill, and B.D. Freeman, "Metal Organic Framework Membranes," PCT Application Number PCT/AU2018/051341, Filed December 14, 2018.

11. H. Wang, H. Zhang, X. Li, J. Lu, A.J. Hill, and B.D. Freeman, "Metal Organic Framework Membranes," U.S. Patent Application US 2020/0384454 A1, Published 10 December 2020.

12. B.D. Freeman, S. Matteucci, and H. Lin, "Metal Oxide Nanoparticle Filled Polymers," International Publication Number WO 2007/084169 A2.

13. B.D. Freeman, H.B. Park, and B.D. McCloskey, "Water Purification Membranes with Improved Fouling Resistance," International Publication WO 2010/006196 A2, January 14, 2010.

14. B.D. Freeman, D.J. Miller, B.D. McCloskey, C.W. Bielawski, and D.R. Dreyer, "Surface deposition of small molecules to increase water purification membrane fouling resistance," U.S. Patent Application Number US 2012/0111791 A1, published May 10, 2012.

15. J. McCutcheon, J. Arena, B. Freeman, and B. McCloskey, "Method of Modifying Thin Film Composite Membrane Support Structures for Engineered Osmosis Applications," U.S. Patent Application Number 2012/0048805 A1, published March 1, 2012.

16. J. McCutcheon, J. Arena, B. Freeman, and B. McCloskey, "Method of Modifying Thin Film Composite Membrane Support Structures for Engineered Osmosis Applications," International Publication Number WO 2012/0097620 A1, published January 19, 2012.

17. D.L. Gin, E.S. Hatakeyama, C.J. Gabriel, B.D. Freeman, and H. Ju, "Polymer Coatings that Resist Adsorption of Proteins," U.S. Patent Application US 2010/0096327 A1, published April 22, 2010.

18. B.D. Freeman, D.J. Miller, and B.D. McCloskey, "Polymer Deposition and Modification of Membranes for Fouling Resistance," U.S. Patent Application US 2010/0059433 A1, published March 11, 2010.

19. B.D. Freeman, D.F. Sanders, C. Ribeiro, Z. Smith, J. McGrath, and R. Guo, "Polymer Synthesis and Thermally Rearranged Polymers as Gas Separation Membranes," U.S. Patent Application 20120329958 A1, published December 27, 2012.

20. B.D. Freeman, D.F. Sanders, C. Ribeiro, Z. Smith, J. McGrath, and R. Guo, "Polymer Synthesis

and Thermally Rearranged Polymers as Gas Separation Membranes," PCT Patent Application WO 2012167114, published December 6, 2012.

21. B.D. Freeman, D.R. Paul, K. Czenkusch, C. Ribeiro, and C. Ba, "Thermally Rearranged (TR) Polymers as Membranes for Ethanol Dehydration," U.S. Patent Application US 20120305484 A1, published December 6, 2012.

22. B.D. Freeman, D.R. Paul, K. Czenkusch, C. Ribeiro, and C. Ba, "TR Polymers as Membranes for Ethanol Dehydration," PCT Patent Application WO 2012166153, published December 6, 2012.