

Christopher J. Durning

Professor, Chemical Engineering, Columbia University, NYC

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Education:

Columbia University, New York NY Chemical Engineering B.S. 1978

Princeton University, Princeton NJ Chemical Engineering M.A 1979

Princeton University, Princeton NJ Chemical Engineering PhD 1983

Graduate Advisors:

W.B. Russel (Princeton, deceased), L. Rebenfeld (Princeton, deceased)

.

Professional Appointments:

2000 - Professor, Chemical Engineering, Columbia

2000 - 2005 Professor and Vice-Chair, Chemical Eng, Columbia

1998 - 2000 Professor, Chemical Eng & Applied Chemistry, Columbia

1988 -1998 Associate Professor; Chemical Eng & Applied Chemistry, Columbia

1983 - 1988 Assistant Professor; Chemical Eng & Applied Chemistry, Columbia

2013 Senior Fellow, Institute for Adv. Studies, University of Bologna, Italy

2006 Visiting Lecturer, Mathematics, Vancouver Island University, BC Canada

1997 Visiting Scientist, Institute of Materials Science, UCONN

1997 Visiting Scientist, Lujan. Neutron Scattering Center, Los Alamos Lab

1993 Visiting Professor, Chem Eng and Mat Sci, U Minnesota

1992 Visiting Professor, Applied Mathematics, CALTECH

1991 Visiting Professor, Chemical Eng., University of Sherbrooke, Quebec CA

1990 Visiting Scientist, Sci Res Labs, Ford Motor, Dearborn MI

1988 Visiting Scientist, Watson Research Center, IBM Yorktown Heights NY

1986 Visiting Professor, Experimental Station, duPont Co., Wilmington DE

1978 - 1981 NSF Fellow; Princeton University, Princeton NJ;

PUBLICATIONS (Peer Reviewed Journals, Book Chapters, Conference Proceedings):

1. Durning C.J., Scott M.G., and Weigmann H.D., "Temperature Dependence of Surface Cavitation in PET Fibers," J. Appl. Polym. Sci. 27, 3597 (1982).
2. Durning C.J. and Rebenfeld L., "Dimensional Changes During Solvent Induced Crystallization of Poly(ethylene Terephthalate)," J. Appl. Polym. Sci. 29, 3188 (1984).
3. Durning C.J., Rebenfeld L., Weigmann H.D. and Russel W.B. in "Polymers for Fibers and Elastomers," J. Arthur ed., ACS, Washington DC (1984).
4. Durning C.J. and Russel W.B., "A Mathematical Model for Diffusion with Induced Crystallization I," Polymer 26, 119 (1985).
5. Durning C.J. and Russel W.B., "A Mathematical Model for Diffusion with Induced Crystallization II," Polymer 26, 131 (1985).
6. Durning C.J., Spencer J.L. and Tabor M., "Differential Sorption and Permeation in Viscous Media," J. Polym. Sci. Letters Edn. 23, 171 (1985).
7. Durning C.J., "Differential Sorption in Viscoelastic Fluids," J. Polym. Sci. Phys. Edn. 23, 1831 (1985).
8. Durning C.J., Rebenfeld L. and Russel W.B., "Integral Sorption with Induced Crystallization," Polym. Eng. & Sci. 26, 1066 (1986).
9. Durning C.J., Rebenfeld L. and Russel W.B., "Solvent Induced Crystallization of Poly(ethylene terephthalate) I: Crystallization Kinetics," J. Polym. Sci., Phys. Edn. 24, 1321 (1986).
10. Durning C.J., Rebenfeld L. and Russel W.B., "Solvent Induced Crystallization of Poly(ethylene terephthalate) II: Morphology," J. Polym. Sci., Phys. Edn. 24, 1341(1986).
11. Durning C.J. and Tabor M., "Mutual Diffusion in Concentrated Polymer Solutions," Macromolecules 19, 2220 (1986).
12. Waywood W. and Durning C.J., "Solvent Induced Crystallization of a Compatible Polymer Blend," Polym. Eng. & Sci. 24, 1265 (1987).
13. Durning C.J. and Secor R.M., "Thermodynamic Properties of Chain Liquid Mixtures with Strong Local Interactions," J. Polym. Sci., Phys. Edn. 26, 91 (1988).
14. Durning C.J. and O'Shaughnessy B., "Diffusion Controlled Reactions at an Interface," J. Chem. Phys. 88, 7177(1988).
15. Billovits G. and Durning C.J., "Penetrant Transport in Semi-Crystalline Poly(ethylene terephthalate)," Polymer 29, 1468 (1988).
16. Tong H.M., Saenger K.L. and Durning C.J., "A Study of Solvent Transport in Thin Polyimide Films by Laser Interferometry," J. Polym. Sci., Phys. Edn. 27, 689(1989).
17. Grisafi S. and Durning C.J., "Polymer Adsorption at a Planar Interface," J. Coll. Int. Sci. 130, 35 (1989).
18. Grisafi S. and Durning C.J., "Adsorption of Free-Draining, Gaussian, Bead-Spring Macromolecules at a Plane Interface," J. Coll. Int. Sci., 130, 45 (1989).

19. Billovits G. and Durning C.J., "Polymer Material Coordinates for Mutual Diffusion in Polymer-Penetrant Systems," Chem. Eng. Comm. 82, 21 (1989).
20. Cairault A., Bizot H., Durning C.J. and Roques M.A., "Approaching Viscoelastic Diffusion in Polyacrylamide Gels," in "Drying '89," Mujumdar A.S. ed., Hemisphere, Washington DC (1989).
21. DeKee D. and Durning C.J., "Rheology of Materials with a Yield Stress," in "Polymer Rheology and Processing," Collyer A.A. and Utracki L.A. eds., Elsevier, New York (1990).
22. O'Shaughnessy B., Durning C.J. and Tabor M., "Polymer Deformation in Strong, High-Frequency Flows," J. Chem. Phys. 92, 2637 (1990).
23. Mehdizadeh S. and Durning C.J., "Prediction of Differential Sorption Kinetics Near T_g for Benzene in Polystyrene," AIChE J. 36, 877 (1990).
24. Billovits G. and Durning C.J., "Two Stage Weight Gain in the Polystyrene-Ethylbenzene System," Polymer Comm. 31, 359 (1990).
25. Fu T.Z., Durning C.J. and Tong H.M., "Simple Model for Swelling-Induced Stresses in a Supported Polymer Film," J. Appl. Polym. Sci. 43, 709 (1991).
26. Chu Y.Z. and Durning C.J., "Application of the Blister Test to the Study of Polymer-Polymer Adhesion," J. Appl. Polym. Sci., 45, 1151 (1992).
27. Jeong H.S., Chu Y.Z., Durning C.J. and White R.C., "Adhesion Study of Polyimide to Si Surfaces," Surf. & Int. Anal., 19, 303 (1992).
28. Chu Y.Z. and Durning C.J., "A Technique for Accurate Characterization of Adhesion Between Incompatible Polymers," in "Polymer Blends, Solutions and Interfaces," Noda I. and Rubingh D.N. eds., Elsevier, New York (1992).
29. Chu Y.Z., Durning C.J., Jeong H.S. and White R.C., "The Adhesive Strength of Polyimide/Metal and Polyimide/Silicon Interfaces as Determined by the Blister Test," in "Metallized Plastics III: Fundamental and Applied Aspects," Mittal K. ed., Plenum, New York, (1992).
30. Jeong H.S., Chu Y.Z., Durning C.J. and White R.C., "Thin Film Adhesion Studies in Microelectronic Packaging," Mat. Res. Soc. Symp. Proc., 239, 547 (1992).
31. Chu Y.Z., Jeong, H.-S., White R.C. and Durning C.J., "Characterization of Adhesion in Thin Film Materials by the Blister Test," Mat. Res. Soc. Symp. Proc., 276, 209 (1992).
32. Chu Y.Z. and Durning C.J., "Effect of Thermal Degradation on the Adhesion of Polyimide/Silicon Interfaces," Mat. Res. Soc. Symp. Proc., 282, 587 (1993).
33. Durning C.J. and Morman K.N., "Nonlinear Swelling of Polymer Gels," J. Chem. Phys., 98, 4275 (1993).
34. Fu T.Z. and Durning C.J., "Numerical Simulation of Case II Transport," AIChE J., 39, 1030 (1993).
35. Fu T.Z., Stimming U. and Durning C.J., "Kinetics of Polystyrene Adsorption onto Gold from Dilute, Theta Solutions," Macromolecules, 26, 3271 (1993).

36. Billovits G.F. And Durning C.J., "Linear Viscoelastic Diffusion in the Poly(styrene)/Ethylbenzene System: Differential Sorption Experiments," *Macromolecules*, 26, 6927 (1993).
37. Monahan M.D. and Durning C.J., "A Tensile Rheometer for Solid Polymers Containing Volatile Diluents," *J. Appl. Polym. Sci.*, 51, 213 (1994).
38. Billovits G.F. and Durning C.J., "Linear Viscoelastic Diffusion in the Poly(styrene)-Ethylbenzene System: Comparison Between Theory and Experiment," *Macromolecules*, 27, 7630 (1994).
39. Durning C.J., Hassan M.M., Tong H.M. and Lee K.W., "A Study of Case II Transport by Laser Interferometry," *Macromolecules*, 28, 4234 (1995).
40. Pan W.-S., Bossman S., Durning C.J. and Turro N.J., "Mobility Redistribution of Spin Labels on Adsorbed Polystyrene," *Macromolecules*, 28, 7284 (1995).
41. Durning C.J., Edwards D.A. and Cohen D.S., "Perturbation Analysis of Thomas and Windle's Model of Case II Transport," *AIChE J.*, 42, 2025 (1996).
42. Cairncross R.A. and Durning C.J., "A Model for Drying of Viscoelastic Polymer Coatings," *AIChE J.*, 42, 2415 (1996).
43. Pan W.-S., Durning C.J. and Turro N.J., "An In-Situ Study of the Kinetics of Monolayer Formation of Alkylthiols on Gold with a Quartz Crystal Microbalance," *Langmuir*, 12, 4469 (1996).
44. Srinivas B., Durning C.J. and Turro N.J., "Response of Adsorbed Polystyrene Layers to Desorption Conditions," *Macromolecules*, 29, 5505 (1996).
45. Chin S., Gaskins T. and Durning C.J., "Steady-State Permeation of Carbon Dioxide through a Miscible, Glassy Polymer Blend," *J. Polym. Sci., Part B: Polymer Physics*, 34, 2689 (1996).
46. Lee K.W., Paek S.-H., Lien A., Durning C.J. and Fukuro H., "Microscopic Molecular Reorientation of Alignment Layer Polymer Surfaces Induced by Rubbing and its Effect on LC Pretilt Angles," *Macromolecules*, 29, 8894 (1996).
47. S.J. Huang and C.J. Durning, "Nonlinear Viscoelastic Diffusion in Concentrated Polystyrene-Ethylbenzene Solutions," *J. Polym. Sci.: Part B: Polym. Phys.*, 35, 2103 (1997).
48. M.M. Hasan, C.J. Durning, H.M. Tong, and K.W. Lee, "The Effects of Polymer Molecular Weight and Temperature on Case II Transport in the Poly(Methylmethacrylate)/methanol System," in *Polymer Surfaces and Interfaces: Characterization, Modification and Application*, K.L. Mittal and K.W. Lee eds., VSP, Utrecht, Netherlands, 1997.
49. K.W. Lee, S. H. Paek, A. Lien, C.J. Durning, and H. Fukuro, "Microscopic Molecular Re-orientation of Polymer Surfaces Induced by Rubbing and Factors Determining LC Pretilt Angles," in *Polymer Surfaces and Interfaces: Characterization, Modification and Application*, K.L. Mittal and K.W. Lee eds., VSP, Utrecht, Netherlands, 1997.
50. P.H. Tang, C.J. Durning, C.J. Gou, and D.DeKee, "Effect of Molecular Weight on Two-Stage Sorption in Concentrated Polystyrene-Ethylbenzene Solutions," *Polymer*, 38, 1845 (1997).

51. U. Sawhney, C.J. Durning, B. O'Shaughnessy, G.S. Smith, and J. Majewski, "Irreversible Adsorption of Polymer Melts," *Mat. Res. Soc. Symp. Proc.*, 464, 219 (1997).
52. J.J. Kelly, K.M. A. Rahman, C.J. Durning, and A.C. West, "Effect of Current Distribution on Quartz Crystal Microbalance Measurements," *J. Electrochem. Soc.*, 145, 492 (1998).
53. S. H. Paek, C.J. Durning, K.W. Lee, and A. Lien, "A Mechanistic Picture of the Effects of Rubbing on Polyimide Surfaces and Liquid Crystal Pretilt Angles," *J. Appl. Phys.*, 83, 1270 (1998).
54. E. Nwankwo and C.J. Durning, "Mechanical Response of Thickness-Shear Mode Quartz-Crystal Resonators to Linear Viscoelastic Fluids," *Sensor and Actuators A*, 64, 119 (1998).
55. S.J. Huang, C.J. Durning, and B.D. Freeman, "Modeling Weakly Non-linear Two-stage Sorption Kinetics in Glassy Polymer Films," *J. Membrane Sci.*, 143, 1 (1998).
56. S.H. Paek and C.J. Durning, "Stability Analysis of a Nonlinear Blister Test," *J. Adhesion*, 68, 269 (1998).
57. E. Nwankwo and C.J. Durning, "Impedance Analysis of Thickness-Shear Mode Quartz Crystal Resonators in Contact with Linear Viscoelastic Media," *Rev. Sci. Instr.*, 69, 2375 (1998).
58. S.H. Paek, K.W. Lee and C.J. Durning, "Effect of Environment on the Measured Values of the Adhesion of Polyimide to Silicon," *J. Adhesion Sci. Technol.*, 13, 423 (1999).
59. C.J. Durning, P.H. Tang, and R.A. Cairncross, "A One-dimensional Model for Viscoelastic Diffusion in Polymers," in *Advances in the Flow and Rheology of Non-Newtonian Fluids*, Part B, D. Siginer, D. DeKee and R.P. Chabira, eds, Elsevier, NY, 1999, p. 1489.
60. E. Nwankwo, C.J. Durning, "Fluid Property Investigation by Impedance Characterization of Quartz Crystal Resonators Part I: Methodology, Crystal Screening and Newtonian Fluids," *Sensor and Actuators A*, 72, 99 (1999).
61. E. Nwankwo and C.J. Durning, "Fluid Property Investigation by Impedance Characterization of Quartz Crystal Resonators Part II: Parasitic Effects, Viscoelastic Fluids," *Sensor and Actuators A*, 72, 195 (1999).
62. W. Chen, C.J. Durning and N.J. Turro, "Photodegradation of Pyrene-Labeled Polystyrene Adsorbed on a Silica Surface in Chloroform," *Macromolecules*, 32, 4151 (1999).
63. C.J. Durning, U. Sawhney, B. O'Shaughnessy, G.S. Smith, J. Majewski, D. Nguyen, "Irreversible Adsorption of Polymethylmethacrylate Melts on Quartz," *Macromolecules*, 32, 6772 (1999).
64. M.M. Hassan, C.J. Durning, "Effects of Polymer Molecular Weight and Temperature on Case II Transport," *J. Polym. Sci. Part B: Polym. Phys.*, 37, 3159 (1999).
65. K. Tseng, N.J. Turro, C.J. Durning, "Tracer Diffusion in Thin Polystyrene Films," *Polymer*, 41, 4751 (2000).
66. K. Tseng, N.J. Turro, C.J. Durning, "Molecular Mobility in Polymer Thin Films," *Phys. Rev. E*, 61, 1800 (2000).

67. A. Ponomarev, T. Sewell, C.J. Durning, "Adsorption of Isolated, Flexible Polymers on a Strongly Attractive Surface," *Macromolecules*, **33**, 2662 (2000).
68. A. Ponomarev, T. Sewell, C.J. Durning, "Surface Diffusion and Relaxation of Partially Adsorbed Polymers," *J. Polym. Sci. Part B: Polym. Phys.*, **38**, 1146 (2000).
69. K.M.A. Rahman, C.J. Durning, N.J. Turro and D.A. Tomalia, "Adsorption of Poly(amido amine) Dendrimers on Gold," *Langmuir*, **16**, 10154 (2000).
70. Z. Liu, R. Levicky, J. Cerise, J. Kim, C.Durning, B. O'Shaughnessy, "Organization of Nanoparticles on Soft Polymer Surfaces," *Nanoletters*, **2**, 219 (2002).
71. K.M.A. Rahman, C.J. Durning, S.C. Schneider, M.A. Seitz, W.A. Chiou, "Annealing and Microstructural Characterization of Tin-Oxide Based Thick Film Resistors," *J. Electroceramics*, **9**, 137 (2002).
72. Muller, T., Yablon, D. G., Karcher, R., Knapp, D., Kleinman, M. H., Fang, H. B., Durning, C. J., Tomalia, D. A., Turro, N. J., Flynn, G. W., "AFM Studies of high-Generation PAMAM Dendrimers at the Liquid/Solid Interface," *Langmuir*, **18**(20), 7452-7455 (2002)..
73. Janes, D. W., Durning, C. J., van Pel, D. M., Lynch, M. S., Gill, C. G., Krogh, E. T., "Modeling Analyte Permeation in Cyclindrical Hollow Fiber Membrane Introduction Mass Spectrometry," *Journal of Membrane Science*, **325**(1), 81-91 (2008)..
74. Janes, D. W., Moll, J. F., Harton, S. E., Durning, C. J., "Dispersion Morphology of Poly(methyl acrylate)/Silica Nanocomposites," *Macromolecules*, **44**(12), 4920-4927 (2011)..
75. Janes, D. W., Durning, C. J. "Sorption and Diffusion of n-Alkyl Acetates in Poly(methyl acrylate)/Silica Nanocomposites," *Macromolecules*, **46** (3), 856-866 (2013).
76. Janes, D. W., Kim, J.S., Durning, C. J., "Interval Sorption of Alkyl Acetates and Benzenes in Poly(Methyl Acrylate)," *Industrial & Engineering Chemistry Research*, **52**, 8765-8773 (2013).
77. Escobar-Ferrand, L., Li, D., Lee, D., Durning, C. J., "All-Nanoparticle Layer by Layer Surface Modification of Micro and Ultrafiltration Membranes," *Langmuir*, **30**, 5545 (2014).
78. Doghieri, F.; Minelli, M.; Durning, C. J., "Non-equilibrium thermodynamics of glassy polymers: Use of equations of state to predict gas solubility and heat capacity," *Fluid Phase Equilibria*, **417**, 144-157 (2016).
79. Janes, D. W.; Bilchak, C.; Durning, C.J., "Decoupling energetic modifications to diffusion from free volume in polymer/nanoparticle composites," *Soft Matter*, **13**, 677-685 (2017).
80. Bilchak, C.R., Buenning, E., et al. including Durning, C.J., "Polymer-grafted Nanoparticle Membranes with Controllable Free Volume," *Macromolecules*, **50**, 7111-7120 (2017).
81. Buenning E, Jestin J, Huang Y, Benicewicz BC, Durning CJ, Kumar SK., "Location of Imbibed Solvent in Polymer-Grafted Nanoparticle Membranes," *ACS Macro Lett.*, **7** (9), pp 1051–1055 (2018).

82. Bilchak CR, Huang Y, Benicewicz BC, Durning CJ, Kumar SK., "High-Frequency Mechanical Behavior of Pure Polymer-Grafted Nanoparticle Constructs," ACS MacroLetters 8, 294-298 (2019).
83. Bilchak CR, Jhalaria M, Huang Y, Abbas Z, Midya J, Benedetti FM, Parisi D, Egger W, Dickmann, M, Minelli M, Doghieri F, Nikoubashman A, Durning CJ, Vlassopoulos D, Jestin J, Smith ZP, Benicewicz BC, Rubinstein M, Leibler L, Kumar SK, "Tuning Selectivities in Gas Separation Membranes Based on Polymer-Grafted Nanoparticles," ACS NANO 14, 17174-1718 (2020).
84. Adhikari S, Purushothaman A, Krauskopf AA, Durning C, Kumar SK, Thampi SP, Modeling Polymer Crystallisation Induced by a Moving Heat Sink SOFT MATTER 17, 2518-2529 (2021).
85. Adhikari S, Krauskopf AA, Kumar SK, Thampi SP, Durning CJ., "Boundary Layer Description of Directional Polymer Crystallisation," SOFT MATTER 17, 7755-7768 (2021).
86. Adhikari S, Durning CJ, Fish J, Simon JW, Kumar SK, "Modeling Thermal Welding of Semicrystalline Polymers," MACROMOLECULES 55, 1719-1725 (2022).
87. Chan SY, Jhalaria M, Huang Y, Li R, Benicewicz BC, Durning CJ, Vo T, Kumar SK., "Local Structure of Polymer-Grafted Nanoparticle Melts," ACS Nano, 16, 7, 10404-10411 (2022)
88. Durning CJ, Purushothaman A, Adhikari S, Kumar SK, Thampi S., "Physics of Directional Polymer Crystallization," ACS Macro Lett., 11, 9, 1102-1106 (2022)
89. Purushothaman A, Adhikari S, Durning C, Kumar SK, Thampi SP., "Directional Polymer Crystallization with a Fast-Moving Sink," Soft Matter, 19, 4011-4020 (2023)

Invited lectures (since 2013)

Invited Lecture: NANO-TECHNOLOGY FOR CLEAN WATER, Tuesday October 08, 2013, Institute for Advanced Study, University Of Bologna, Bologna Italy.

Invited Lecture: Fabrication of Nano-Particle Surface-Modified, Micro- and Ultra-Filtration Membranes, Tuesday Dec 03, 2013, Department of Civil, Chemical, Environmental and Materials Engineering, University Of Bologna, Bologna Italy.

Invited Lecture: Performance of Nano-Particle Surface-Modified, Micro- and Ultra-Filtration Membranes, Wednesday Dec 04, 2013, Department of Civil, Chemical, Environmental and Materials Engineering, University Of Bologna, Bologna Italy.

Invited Lecture: Second Law Considerations in the Formulation of Transport Models, Wednesday Dec 11, 2013, Department of Civil, Chemical, Environmental and Materials Engineering, University Of Bologna, Bologna Italy.

Invited Lecture: Morphology of a Model Polymer Nano-Composite, Tuesday Dec 17, 2013, Department of Civil, Chemical, Environmental and Materials Engineering, University Of Bologna, Bologna Italy.

Invited Lecture: Sorption and Transport of Low Molar Mass Species in a Model Polymer Nano-Composite, Wednesday Dec 18, 2013, Department of Civil, Chemical, Environmental and Materials Engineering, University Of Bologna, Bologna Italy.

Invited speaker at COMPFLU 23 conference on soft matter, at IIT Madras Chennai India, Dec. 18-20, 2023

Conference Presentations (since 2015)

Conference Presentation: American Physical Society, Title: Transport Properties of Self-assembled polymer nanocomposite thin films; location/session: APS march meeting, 03/05/2015, Polymer Nanocomposites 1; Co-authors: Eileen Buenning, Sanat Kumar, Christopher Durning

Conference Presentation: 2015 Annual AIChE Meeting, Title: Transport Channels in Polymer-Grafted Nanocomposite Membranes for Vapor Separations; location/session: Salt Lake City UT 11/9/2015, Self-Assembled Soft Materials for Membrane Applications – Separations Division; Co-authors: Eileen Buenning, Connor Bilchak, Sanat K. Kumar, Christopher J. Durning and Brian C. Benicewicz

Conference Presentation: American Physical Society, Title: Chemical and Temperature Effects on Diffusion in a Model Polymer/Nanoparticle Composite; location/session: Baltimore MD 03/16/2016, Session P42: Small Molecule Transport in Polymers and Polymer Nanocomposites I - Industry Day; Co-authors: D. Janes, C. Durning

Conference Presentation: American Physical Society, Title: Controlling Free Volume for Permeability enhancement in Polymer-Grafted Nanocomposites; location/session: Baltimore MD 03/16/2016, Session P42: Small Molecule Transport in Polymers and Polymer Nanocomposites I - Industry Day; Co-authors:

Connor Bilchak, Eileen Buenning, Sanat Kumar, Christopher Durning, Brian Benicewicz.

Conference Presentation: American Physical Society, Title: Polymer Dynamics Effects on Solute Transport in Hairy Nanoparticle Membranes; location/session: Baltimore MD 03/16/2016, Session P38: Glasses Altered by Interfaces II; Co-authors: Connor Bilchak, Eileen Buenning, Sanat Kumar, Christopher Durning, Brian Benicewicz.

Long-Standing Synergistic Activities:

Chemical Engineering Undergraduate Committee, Columbia University
School of Engineering Committee on Instruction, Columbia University
peer reviewer for select technical journals (Langmuir, Soft Matter, Macromolecules)
and funding agencies (NSF)

Collaborators:

Prof. C. G. Gill, Dept. Chemistry, Vancouver Island University, CA; Dr. T. Gsell, Pall Corporation, USA; Prof. E. T. Krogh, Dept. Chemistry, Vancouver Island University, CA; Prof. S. Kumar, Dept. Chemical Eng., Columbia University, USA; Prof. E.F. Leonard, Dept. Chemical Eng., Columbia University, USA; Prof. F. Doghieri, Chemical and Civil Engineering, U Bologna, Italy; Prof. B. Benicewicz, Chemistry U. South Carolina, USA; Prof. A. Moment, Dept. Chemical Eng., Columbia University, USA.; Prof Sumesh Thampi, Chemical Engineering, IIT Madras India

Doctoral Students Sponsored or Co-Sponsored:

G. Billovits (Dow Chemical, Midland MI); M. Monahan (Mobile; Edison NJ); T. Fu (International Paper; Chicago NY); S.J. Huang (current affiliation unknown); Y.Z. Chu (Polaroid, Boston MA); W. Pan (co-supervised; current affiliation unknown); P.H. Tang (Merck; West Point PA); U. Sawhney (co-supervised; IIT Madras, Chemical Engineering Department, India); S.H. Paek (IBM TJ Watson, NY); K.S. Tseng (Lambda Physik, DDR); E. Nwankwo (DuPont, Wilmington DE); A. Ponomarev (UC Berkeley, Applied Math, CA); M. Hassan (current affiliation unknown); W. Chen (cosupervised; current affiliation unknown); D.W. Janes (post doc University of Texas, Austin TX); Luis Escobar-Ferrand (Pall Co., Port Washington NY); Connor Bilchak (co-supervised; Manhattan College); Ellie Buenning (co-supervised; Gore);

Patents

Thin film composite i.e. multi-layer film, fabricating method, involves immersing charged surface of substrate membrane into bath comprising nanoparticle solution to deposit nanoparticle-only layer on portion of charged surface Patent Number: WO2012151197-A1; EP2704856-A1; US2014141176-A1; Patent Assignee: UNIV COLUMBIA NEW YORK; Inventor(s): DURNING C; ESCOBAR-FERRAND L.

Impact absorbing foam, useful as e.g. padding material, a component of a protective helmet, and a padding to protect mechanical or electrical equipment, comprises a polymeric foam, and ceramic particulates dispersed in the

polymeric foam Patent Number: US2014045962-A1; US8883869-B2; Patent Assignee: SCHOFALVI K; KIM J S; DURNING CJ; PROVEE TECHNOLOGIES LLC; Inventor(s): SCHOFALVI K; KIM J S; DURNING CJ.

Impact absorbing foam used as interior pad for football helmet comprises polymeric foam and ceramic particulates dispersed in polymeric foam, where ceramic particulates have specific average diameter and crushing strength Patent Number: US2015020573-A1; US9365692-B2; Patent Assignee: PROVEE TECHNOLOGIES LLC; Inventor(s): SCHOFALVI K; KIM J S; DURNING C J.

Composition for separating components from a fluid comprises a set of graft nanoparticles in which graft nanoparticle contains a population of polymer chains attached to the nanoparticle Patent Number: US2016101386-A1; Patent Assignee: UNIV COLUMBIA NEW YORK; Inventor(s): KUMAR S K; DURNING C J; BUENNING E; et al.

Teaching

In late 2017 I was asked by the department to create two new core graduate courses in place of the one that I taught twice annually (spring/fall) in the area of transport phenomena. The old course, CHEN E4110 X/Y Transport Phenomena III had been in place for more than 30 years, and has been replaced by two modernized courses which I designed, complementary in their content. Each will satisfy the graduate core requirements for transport phenomena yet have minimal overlap, enabling a student to take both for degree credit if desired. The new courses (CHEN E4110X Mechanisms of Transport Phenomena in Fluids, CHEN E4112 Y Transport Phenomena in Fluids and Mixtures) was taught for the first time in the 2018-19 academic year. In connection with these efforts, I am writing an intermediate-level text book in the area of transport phenomena tentatively for Cambridge University press. The emphasis will be on the application of modern non-equilibrium thermodynamics to fluids for engineering applications. This emphasis is one that appears to be needed in the field.

Courses taught in 2020 (including enrollments and student evaluations)

Spring 2020:

CHEN E 4620 X Introduction to Polymers and Soft Materials, 3 points, enrollment 14.

Course Overall Quality 3.00 ; Instructor Overall Quality: Christopher Durning 3.00

CHEN E 4112 Y Transport Phenomena in Fluids and Mixtures, 3 points, enrollment 36.

Course Overall Quality 3.00 ; Instructor Overall Quality: Christopher Durning 3.00

Fall 2020:

CHEN E4140X Engineering Separations Processes, 3 points expected enrollment 30-40.

Course Overall Quality 2.50 ; Instructor Overall Quality: Christopher Durning 2.50

CHEN E 4110 X Mechanisms of Transport Phenomena in Fluids, 3 points expected enrollment 30-40.

Course Overall Quality 3.96 ; Instructor Overall Quality: Christopher Durning 4.38

CHEN E4001 X ESSENTIALS OF CHEM ENGIN A, 3 points, expected enrollment 20-3

Course Overall Quality 4.54 ; Instructor Overall Quality: Christopher Durning 4.69

Courses taught in 2021 (including enrollments and student evaluations)

Spring 2021:

CHEN E 4630 Y Topics in Soft Materials, 3 points, enrollment 25

Course Overall Quality 4.09 ; Instructor Overall Quality: Christopher Durning 4.27

CHEN E 4112 Y Transport Phenomena in Fluids and Mixtures, 3 points, enrollment 29

Course Overall Quality 3.71 ; Instructor Overall Quality: Christopher Durning 4.12

Summer A 2021

CHEN E4620 Introduction to Polymers and Soft Materials, 3 points , enrollment 14

Course Overall Quality 4.75 ; Instructor Overall Quality: Christopher Durning 4.00

Fall 2021:

CHEN E4140X Engineering Separations Processes, 3 points enrollment 27.

Course Overall Quality 3.64 ; Instructor Overall Quality: Christopher Durning 3.79

CHEN E 4110 X Mechanisms of Transport Phenomena in Fluids, 3 points enrollment 43.

Course Overall Quality 4.16 ; Instructor Overall Quality: Christopher Durning 4.10

CHEN E4001 X ESSENTIALS OF CHEM ENGIN A, 3 points, enrollment 17.

Course Overall Quality NA ; Instructor Overall Quality: Christopher Durning NA

Courses taught in 2022 (including enrollments and student evaluations)

Spring 2022:

CHEN E 4620 Y Introduction to Polymers and Soft Materials, 3 points, enrollment 47

CHEN E 4112 Y Transport Phenomena in Fluids and Mixtures, 3 points, enrollment 68

Fall 2022.

CHEN E 4110 X Mechanisms of Transport Phenomena in Fluids, 3 points enrollment 38.

EVALUATION DATA NA

CHEN E4002 X ESSENTIALS OF CHEM ENGIN B, 3 points, enrollment 43

EVALUATION DATA NA

Courses taught in 2023 (including enrollments and student evaluations)
Spring 2023

CHEN E4630Y Topics in Soft Materials, 3 points , enrollment 20, Course:
Overall Quality 4.40, Instructor: Overall Quality: 4.60

I thought Prof. Durning did a excellent job of making this material accessible and engaging for everyone from a 3rd year undergraduate up to phd students. We were able to lean into this class as

much as we wanted/needed to. I chose this class as an elective and took it as an opportunity to get cursory introduction to soft materials. However, if I were looking to design a soft materials

experiment for a phd thesis, Prof. Durning provides the fundamental content (through lecture and literature) necessary to develop a deep understanding of the theory and experimental techniques.

Ultimately, Prof. Durning ensures that students of all skill levels will be able to take something valuable away from this course, and allows to students to decide how much they want to/are able to take away.

CHEN E4112 Y Transport Phenomena in Fluids and Mixtures, 3 points, enrollment 76. Course: Overall Quality 3.58, Instructor: Overall Quality: 3.79
Fall 2023

CHEN E4620X Introduction to Polymers and Soft Materials, 3 points enrollment 31, Course: Overall Quality 4.78, Instructor: Overall Quality: 4.78

CHEN E 4110 X Mechanisms of Transport Phenomena in Fluids, 3 points enrollment 50-60; Course: Overall Quality 4.14, Instructor: Overall Quality: 4.38

He did an excellent job of explaining transport phenomena, which is understandably a difficult subject.

- *Mechanisms of Transport is one of the toughest courses in Chemical Engineering, yet the professor tried his best to deliver it in the easiest way possible and make us understand the concepts.*

- *Though the concepts we learned about were very complex, the format of the course, which encouraged regular attendance and participation, made the class engaging and not stressful. Professor Durning patiently answered our questions during office hours which helped a great deal with my understanding of the material. Connections between fundamental transport concepts and new research frontiers were also very interesting*

CHEN E4001 X ESSENTIALS OF CHEM ENGIN A, 3 points, enrollment

CHEN E4002 X ESSENTIALS OF CHEM ENGIN B, 3 points, enrollment,
Overall Quality 4.3, Instructor: Overall Quality: 4.67

Amazing amazing professor! Super kind, caring and accessible. Transport is a very difficult module but he did a great job explaining it and even made it enjoyable for us to learn! He even showed up to lecture while being sick (did tell us to be at a distance and wore a mask!) because he didn't want us to fall behind. Genuinely nice and sweet person. I have so much love and respect for professor Durning! Can't wait to take the core transport class with him

Courses taught in 2024 (including enrollments and student evaluations)

Spring 2024

CHEN E4630Y Topics in Soft Materials, 3 points , enrollment 16, IN PROGRESS

CHEN E4112 Y Transport Phenomena in Fluids and Mixtures, 3 points,
enrollment 52, IN PROGRESS.

Fall 2024

CHEN E4620X Introduction to Polymers and Soft Materials, 3 points ex-
pected enrollment 20-30.

CHEN E 4110 X Mechanisms of Transport Phenomena in Fluids, 3 points
expected enrollment 50-60.

CHEN E4001 X ESSENTIALS OF CHEM ENGIN A, 3 points, expected
enrollment 20-30

CHEN E4002 X ESSENTIALS OF CHEM ENGIN B, 3 points, expected
enrollment 20-30

Courses taught in 2025 (including enrollments and student evaluations)

Spring 2025

CHEN E4630Y Topics in Soft Materials, 3 points , expected enrollment 20-30

CHEN E4112 Y Transport Phenomena in Fluids and Mixtures, 3 points,
expected enrollment 50-60.