­Professor (Emeritus) Mark A. McHugh

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11 December 2019

**Education**

Ph.D., Chemical Engineering, University of Delaware, 1981

B.S., Chemical Engineering, Carnegie-Mellon University, 1975

**Professional Experience**

Professor, Department of Chemical and Life Science Engineering, Virginia Commonwealth University, 1999-2014 (currently, Emeritus Professor)

Co-Director, Materials Science Division, Virginia Commonwealth University Reanimation Engineering Science Center (VCURES), 2011-2013

Professor, 1991-1999; Associate Professor, 1987-1991; Assistant Professor, 1985-1987, Department of Chemical Engineering, The Johns Hopkins University

Assistant Professor, Department of Chemical Engineering, University of Notre Dame, 1981-1985

Process Engineer, FMC Corporation, Chemical R&D, Princeton, NJ, 1975-1976

**Awards and Honors**

Finalist, 2014 Institution of Chemical Engineers Global Awards, Core Chemical Engineering Category; Team Members: Isaac Gamwo (ORD), Robert Enick (NETL-RUA), Mark McHugh (VCU), Deepak Tapriyal (URS), and Ward Burgess (ORISE)

Virginia Commonwealth University 2014 Distinguished Scholarship Award, August 2014

Faculty Excellence Award for Teaching in Chemical and Life Science Engineering, awarded by the Engineering Student Council, February 2014

Visiting Professor, Lehrstuhl für Thermische Verfahrenstechnik, Friedrich-Alexander-University, Erlangen-Nuremberg, May-Dec. 2007

Kipping Visiting Professor, Chemistry Department, University of Nottingham, March 1996

Visiting Professor, Institut für Physikalische Chemie, Universität Göttingen, May–Dec. 1994

JHU Oraculum Award for Excellence in Undergraduate Teaching, F92, F93, S94, S95

Keynote Address, Meeting of the Society of Chemistry and Industry, London, November 1993

Battelle Memorial Institute Research Award, October, 1984

Amoco Foundation Young Faculty Award, 1982

**Research Interests**

High-Pressure Fluid Properties and Phase Equilibria; Polymer Solution Behavior at High Pressures; Scattering Phenomena in Polymer Solutions at High Pressures; Supercritical Fluid Solvent Technology

**Professional Memberships**

American Chemical Society

• Polymers Material Science & Engineering Division

• Polymer Chemistry Division

American Physical Society: High Polymer Physics

**Professional Activities**

Editorial Advisory Board

Journal of Supercritical Fluids, 1990-Present

Journal of Chemical & Engineering Technology, 1998-2010

Journal of Chemical and Engineering Data, 1998-2001

Committee Membership

Executive Committee and Program Chair

10th International Symposium on Supercritical Fluids, San Francisco, CA, May 2012

2nd International Symposium on Supercritical Fluids, Boston, MA, October 1991

Scientific Advisory Board

Organizing Committee, Asia Pacific Symposium on Process Intensification & Sustainability, Changzhou, China, May 2014

Organizing Committee, SAE 2013 Fuels, Lubricants, and Aftertreatment Symposium, Session on Lubricants: Fundamental Research and Polymer Technology, Long Beach, CA, Nov. 2013

Organizing Committee, International Conference on Process Intensification for Sustainable Chemical Industries (ICPI 2011), Beijing, China, June 2011

SuperGreen 2011 - 7th International Conference on Supercritical Fluids, Beijing, China, Aug. 2011

8th International Symposium on Supercritical Fluids, Kyoto, Japan, Nov. 2006

5th International Symposium on Supercritical Fluids, Atlanta, GE, Apr. 2000

4th International Symposium on Supercritical Fluids, Sendai, Japan, May 1997

3rd International Symposium on Supercritical Fluids, Strasbourg, France, Oct. 1994

4th Int. Symposium on High Pressure Process Tech. & Chem. Eng., Venice, Italy, Sept. 2002

6th Int. World Congress of Chem. Eng., High-Pressure Processes, Australia, Sept. 2001

1st Int. Symposium on Sci., Eng., Tech. of Intensive Processing, Nottingham, UK, Sept. 1995

External Advisory Board, NSF Science & Technology Center, Department of Chemistry, University of North Carolina, July 2002 - April 2003

Advanced Courses in Supercritical Fluid Technology

“Supercritical Fluid Extraction: Principles and Practice,” a 2day course, Boston, MA (1990-2000), JHU (1986-89), University of Notre Dame (1984-85), Battelle Northwest, WA (1985), and the Jysk Institute, Denmark (1989); co-lecturer: V.J. Krukonis.

“Thermodynamics of Supercritical Fluid Systems,” a 2-day course, Los Alamos, NM, March 1997; co-lecturer: M.E. Paulaitis.

“Processing With Supercritical Fluids,” a 1-day course presented at AIChE Meetings (1989-90; 1983-85), co-lecturer: V.J. Krukonis.

**Graduate Students**

**Directed at Virginia Commonwealth University** (1999-present)

Doctoral

Aaron J. Rowane, "Diesel fluid properties at high-temperature, high-pressure conditions," expected from City, University of London, 8/19

Matthew S. Newkirk, “Behavior of star polymers in solution at high pressure,” 12/16

Babatunde Bamgbade, “Experiments and modeling of hydrocarbon mixtures at extreme conditions,” 8/15

Yue Wu, “High-pressure studies of star polymer solutions,” 12/13

Kimberly Lott (Chemistry PhD), “The synthesis, regioregularity, kinetics, and supercritical fluid solubilities in biphenyl dibenzoates and alkyl/fluoroalkyl poly(p-phenylene)s,” co-advised with Professor Michael Wright, Department of Chemistry, VCU, 1/05

Masters

Aaron J. Rowane, "High pressure viscosity of hydrocarbon mixtures," 12/15

Michael A. Marin, "Aerogels from polysaccharides," 5/14

Babatunde Bamgbade, “Solution properties of hydrocarbon mixtures at extreme conditions,” 12/12

Yue Wu, “High-pressure experimental studies of hydrocarbons solutions,” 9/10

Ntoh Etem-Tambe, “Characterization of fluoropolymer powders made by supercritical-assisted mixing with crystalline additives,” 12/05 -- co-advised with Gary S. Huvard

**Graduate Students**

**Directed at The Johns Hopkins University** (1985-2001)

Doctoral

Thomas W. Kermis, “Development of a high-pressure dynamic light scattering instrument to investigate the impact of solvent size on polymer conformational behavior in dilute solutions,” 1/01

Shawn E. Conway, “Development of a high-pressure surface plasmon resonance spectroscopy sensor to monitor polymer adsorption,” 1/01

Christopher F. Kirby, “Spectroturbidimetric study of the phase separation kinetics of polymer-supercritical fluid mixtures,” 10/00

Todd P. DiNoia, “Impact of solvent quality and polymer architecture on polymer-supercritical fluid solutions: Phase behavior and small-angle neutron scattering investigations,” 5/00

Cynthia Mertdogan, “Effects of intermolecular forces and backbone architecture on the phase behavior of fluoropolymer-supercritical fluid mixtures,” 10/97

Sang-Ho Lee, “Cosolvent and molecular weight effects on acid copolymer mixtures,” 5/95

Bruce M. Hasch, “Hydrogen bonding and polarity in ethylene copolymer-solvent mixtures: Experiments and Modeling,” 9/94

Melchior A. Meilchen, “Thermodynamics of copolymer solutions at high pressures,” 9/91

Ronald A. Dombro, “Electrochemistry in the critical region” (co-advisor, G.A. Prentice), 9/90

Galen J. Suppes, “Reaction engineering in supercritical media--catalytic and noncatalytic free-radical reactions,” 12/88

Ronald N. Occhiogrosso, “Free-radical oxidation of cumene in supercritical media,” 10/87

Alan K. McClellan, “Thermodynamics of polymer solutions,” 5/86

Masters

J. Alan Pratt, “Fractionating polymers with supercritical fluids,” 5/94

Minna A. LoStracco, “Effect of alcohol cosolvents on copolymer solution behavior,” 12/93

Beverly Eichelberger, “Temperature-composition behavior of ethylene-methyl acrylate copolymers in octanol and hexadecane,” 5/92

Veljko Roskar, “Dielectric behavior of mixtures in the liquid and critical regions,” 10/90

James J. Watkins, “Experimental program to determine the effect of shear on the high pressure phase behavior of polymer solutions,” 10/88

Mary B. Kiszka, “Experimental and modeling techniques used in the determination of high-pressure phase behavior,” 9/87

Andrew J. Seckner, “Experimental studies of supercritical fluid phase behavior,” 4/87

**Graduate Students**

**Directed at The University of Notre Dame**

(1981-1985)

Masters

Ronald N. Occhiogrosso, “High-pressure phase behavior of organic hydrocarbon-supercritical carbon dioxide mixtures,” 5/85

Jeffrey T. Igel, “Model calculations of the phase behavior of mixtures at high pressures,” 9/84

Irene S. Liau, “High-pressure behavior of solid polymer-supercritical solvent systems,” 12/83

Nicole Remily, “Supercritical solvent extraction of a paraffin-naphthene system,” 9/83

Masters (12 month, nonthesis program)

Mayank Patel and Mark W. Mallett, 1/81-1/82

Thomas J. Yogan, Rimas Victora, and James Mladenik, 9/81-6/82

Marc V. Malone, 6/82-6/83

Evan G. Bauman, 9/83-8/84

**Publications**

Books Authored

McHugh, M.A. and V.J. Krukonis, “Supercritical Fluid Extraction: Principles and Practice,” Butterworth, Stoneham, MA, 2nd Edition, 512 pages, January 1994; 1st Edition, April 1986.

Books Edited

McHugh, M.A., Editor: “Proceedings of the 2nd International Symposium on Supercritical Fluids,” May 1991.

Penninger, J.M.L., Radosz, M., McHugh, M.A., and V.J. Krukonis, Editors: “Symposium Proceedings on Supercritical Fluid Technology,” Elsevier Science Publishers, October 1985.

Refereed Articles (~150)

**2019**

Baled, H.O., Enick, R.M., Mallepally, R.R., Bamgbade, B.A., McHugh, M.A., Billingsley, M.C., "Viscosity measurement and modeling of rocket propellant RP-2 over wide ranges of temperature and pressure," Fuel, revised and resubmitted December 2019.

Rowane, A.J., Gupta, A., Gavaises, M., Wensing, M., M.A. McHugh, "Vapor-liquid equilibria and mixture densities for three different diesel + N2 mixtures to 535 K and 170 MPa," Fuel, revised and resubmitted December 2019.

Rowane, A.J., Gavaises, M., and M.A. McHugh*,*  "Vapor-liquid equilibria and mixture densities for 2,2,4,4,6,8,8-heptamethylnonane + N2 and n-hexadecane + N2 binary mixtures to 535 K and 135 MPa," Fluid Phase Equilibria, **506**, https://doi.org/10.1016/j.fluid.2019.112378 (2019).

Rowane, A.J., Babu, V.M., Rokni, H.B., Moore, J.D., Gavaises, M., Wensing, M., Gupta, A., M.A. McHugh, "Effect of composition, temperature, and pressure on the densities and viscosities of three diesel fuels," Journal of Chemical and Engineering Data, DOI: 10.1021/acs.jced.9b00652 (2019).

Mallepally, R.R., Bamgbade, B.A., McHugh, M.A., Baled, H.O., Enick, R.M., and M.C. Billingsley, "Measurements and modeling of the density of rocket propellant RP-2 at temperatures to 573 K and pressures to 100 MPa," Fuel, **253**, 1193-1203 (2019).

Bamgbade, B.A., Mallepally, R.R., Cain, N., and M.A. McHugh, "Mixture densities and viscosities of toluene with ethylene or propylene at temperatures to 530 K and pressures to 70 MPa," Fluid Phase Equilibria, **498**, 122-131 (2019).

Rowane, A.J., Mallepally, R.R., Gupta, A., Gavaises, M., and M.A. McHugh*,* "High-Temperature, high-pressure viscosities and densities of n-hexadecane, 2,2,4,4,6,8,8-heptamethylnonane and squalane measured using a universal calibration for a rolling-ball viscometer/densimeter," Industrial and Engineering Chemistry Research, **58**, 4303-4316 (2019).

Rokni, H.B., Moore, J.D., Gupta, A., McHugh, M.A., Mallepally, R.R., M. Gavaises, "General method for prediction of thermal conductivity for well-characterized hydrocarbon mixtures and fuels up to extreme conditions using entropy scaling," Fuel, **246**, 594-604 (2019).

Rokni, H.B., Moore, J.D., Gupta, A., McHugh, M.A., and M. Gavaises, "Entropy scaling based viscosity predictions for hydrocarbon mixtures and diesel fuels up to extreme conditions," Fuel, **241**, 1203-1213 (2019).

Rokni, H.B., Gupta, A., Moore, J.D., McHugh, M.A., Bamgbade, B.A., and M. Gavaises, "Purely predictive method for density, compressibility, and expansivity for hydrocarbon mixtures and diesel and jet fuels up to high temperatures and pressures," Fuel, **236**, 1377-1390 (2019).

**2018**

Vidal, A., Rodriguez, C., Koukouvinis, P., Gavaises, M., and M.A. McHugh, "Modelling diesel fuel properties through its surrogates using PC-SAFT," International Journal of Engine Research, [https://doi.org/10.1177/1468087418801712](https://doi.org/10.1177%2F1468087418801712) (2018).

Rodriguez, C., Vidal, A, Koukouvinis, P., Gavaises, M., M.A. McHugh, **"**Simulation of transcritical and supercritical fluid jets using the PC-SAFT EoS," Journal of Computational Physics, **374**, 444-468 (2018).

Teixeira, S.C.M., Leao, J.B., Gagnon, C., M.A. McHugh, "High pressure cells for bio-SANS studies under sub-zero and heat denaturing conditions," Journal of Neutron Research, **20**, 1-11 (2018).

Baled, H.O., Gamwo, I., Enick, R.M., and M.A. MccHugh, "Viscosity models for pure hydrocarbons at extreme conditions:  State-of-the-art review and comparative study," Fuel, **218**, 89-111 (2018).

Mallepally, R.R., Bamgbade, B.A., Rowane, A.J., Rokni, H.B., Newkirk, M.S., and M.A. McHugh, "Fluid properties at high pressures and temperatures: Experimental and modelling challenges," Journal of Supercritical Fluids, **134**, 33-40 (2018).

**2017**

Rowane, A.J., Mallepally, R.R., Bamgbade, B.A., Newkirk, M.S., Baled, H.O., Burgess, W.A., Gamwo, I.K., Tapriyal, D., Enick, R.M., and M.A. McHugh, "High-Temperature, high-pressure viscosities and densities of toluene," Journal of Chemical Thermodynamics, **115**, 34-46 (2017).

Mallepally, R.R., Bamgbade, B.A., Cain, N., and M.A. McHugh, "Phase behavior and densities of propylene plus toluene and ethylene plus toluene mixtures to 580 K and 70 MPa," Fluid Phase Equilibria, **449**, 138–147 (2017).

**2016**

Mallepally, R.R., Gadepalli, V.S., Cain, N., and M.A. McHugh, "Phase behavior and densities of propylene + hexane binary mixtures to 585 K and 70 MPa," Journal of Chemical and Engineering Data, **61**, 2818–2827 (2016).

Baled, H.O., Tapriyal, D., Gamwo, I., Bamgbade, B., McHugh, M.A., and R.M. Enick, "Viscosity measurements of two potential deepwater viscosity standard reference fluids at high temperature and high pressure," Journal of Chemical and Engineering Data, **61**, 2712–2719 (2016).

Baled, H.O., Koronaios, P., Xing, D., Miles, R., Tapriyal, D., Gamwo, I., Newkirk, M.S., Mallepally, R.R., McHugh, M.A., and R.M. Enick, "High-Temperature, high-pressure viscosity of n-octane and isooctane," Fuel, **164**, 199-205 (2016).

**2015**

Bamgbade, B.A., Wu, Y., Burgess, W.A., Tapriyal, D., Gamwo, I.K., Baled, H.O., Enick, R.M., and M.A. McHugh, "High-temperature, high-pressure volumetric properties of propane, squalane, and their mixtures: Measurement and PC-SAFT modeling," Industrial & Engineering Chemistry Research, **54**, 6804–6811 (2015).

Mallepally, R.R., Marin, M.A., Montesdeoca, N., Parrish, C., Ward, K.R., and M.A. McHugh, "Hydrogen peroxide loaded cellulose acetate mats as controlled topical O2 delivery devices," Journal of Supercritical Fluids, **105**, 77-83, (2015).

Mallepally, R.R., Marin, M.A., Surampudi, V., Subia, B., Rao, R.R., Kundu, S.C., and M.A. McHugh, "Silk fibroin aerogels: Potential scaffolds for tissue engineering applications," Biomedical Materials, **10**, 035002 (2015).

Bamgbade, B.A., Wu, Y., Burgess, W.A., Tapriyal, D., Gamwo, I., Baled, H.O., Enick, R.M., and M.A. McHugh, “Measurements and modeling of high-temperature, high-pressure density for binary mixtures of propane with *n*-decane and propane with *n*-eicosane,” Journal of Chemical Thermodynamics, **84**, 108-117 (2015).

**2014**

Mallepally, R.R., Parrish, C.C., McHugh, M.A., and K.R. Ward, "Hydrogen peroxide filled poly(methyl methacrylate) microcapsules: potential oxygen delivery materials," International Journal of Pharmaceutics, **475**, 130-137 (2014).

Mallepally, R.R., Marin, MA., and M.A. McHugh, “CO2-assisted synthesis of silk fibroin hydrogels and aerogels,” Acta Biomaterialia, **10**, 4419-4424 (2014).

Wu, Y., Dudek, S.T., Bamgbade, B.A., and M.A. McHugh, "High-pressure phase behavior of boltorn hyperbranched polymers in supercritical fluids," Fluid Phase Equilibria, **382**, 180–186 (2014).

Wu, Y., Newkirk, M.S., Dudek, S.T., Williams, K., Krukonis, V.J., and M.A. McHugh, "Architectural effects on the solution behavior of linear and star polymers in propane at high pressures," Industrial & Engineering Chemistry Research, **53**, 10133-10143 (2014).

Marin, M.A., Mallepally, R.R., and M.A. McHugh, "Silk fibroin aerogels for drug delivery applications," Journal of Supercritical Fluids, **91**, 84-89 (2014).

Burgess, W.A., Tapriyal, D., Gamwo, I.K., Wu, Y., McHugh, M.A., and R.M. Enick, “New group-contribution parameters for the calculation of PC-SAFT parameters for use at pressures to 276 MPa and temperatures to 533 K,” Industrial & Engineering Chemistry Research, **53**, 2520-2528 (2014).

Baled, H.O., Xing, D., Katz, H., Tapriyal, D., Gamwo, I.K., Soong, Y., Bamgbade, B.A., Wu, Y., McHugh, M.A., and R.M. Enick, “Viscosity of n-hexadecane, n-octadecane, and n-eicosane at pressures up to 243 MPa and temperatures up to 534 K,” Journal of Chemical Thermodynamics, **72**, 108-116 (2014).

**2013**

Baled, H.O., Tapriyal, D., Morreale, B.D., Soong, Y., Krukonis, V.J., Babatunde, B.A., Wu, Y., McHugh, M.A., Burgess, W.A., and R.M. Enick, "Exploratory characterization of a perfluoropolyether oil as a possible viscosity standard at deepwater production conditions of 533 K and 241 MPa," International Journal of Thermophysics, **34**, 1845-1864 (2013); data correction in **36**, 807-808 (2015).

Burgess, W.A., Tapriyal, D., Morreale, B., Soong, Y., Baled, H.O., Enick, R.M., Wu, Y., Bamgbade, B.A., and M.A. McHugh, "Volume-translated cubic EoS and PC-SAFT density models and a free volume-based viscosity model for hydrocarbons at extreme temperature and pressure conditions, Fluid Phase Equilibria, **359**, 38-44 (2013).

Wu, Y., Bamgbade, B.A., Baled, H.O., Enick, R.M., Burgess, W.A., Tapriyal, D., and M.A. McHugh, "Liquid densities of xylene isomers and 2-methylnaphthalene at temperatures to 523 K and pressures to 265 MPa: Experimental determination and equation of state modeling," Industrial & Engineering Chemistry Research, **52**, 11732–11740 (2013).

Wu, Y., Bamgbade, B.A., Burgess, Tapriyal, D., W.A., Baled, H.O., Enick, R.M., and M.A. McHugh, "Effect of isomeric structures of branched cyclic hydrocarbons on densities and equation of state predictions at elevated temperatures and pressures," Journal of Physical Chemistry B, **117**, 8821–8830 (2013).

Bamgbade, B.A., Wu, Y., Baled, H.O., Enick, R.M., Burgess, W.A., Tapriyal, D., and M.A. McHugh, "Experimental density measurements of bis(2-ethylhexyl) phthalate at elevated temperatures and pressures," Journal of Chemical Thermodynamics, **63**, 102-107 (2013); data correction in **76**, 172 (2014).

Wu, Y., Liu, K., Bamgbade, B., and M.A. McHugh, "Investigation on the solidification of several pure cyclic and aromatic hydrocarbons at pressures up to 300 MPa," Fuel, **111**, 75-80, (2013).

Mallepally, R.R., Bernard, I., Marin, M.A., Ward, K. R., and M.A. McHugh, "Superabsorbent alginate aerogels," Journal of Supercritical Fluids, **79**, 202-208 (2013).

Ward, K., Huvard, G., McHugh, M.A., Mallepally, R.R., and R. Imbruce, "Chemical oxygen generation," Respiratory Care, **58**, 184-195 (2013).

Kirsch, C., Dahms, J., Kostko, A.F., McHugh, M.A., and I. Smirnova, "Pressure assisted stabilization of biocatalysts at elevated temperatures: characterization by dynamic light scattering," Biotechnology & Bioengineering, **110**, 1674-1680 (2013).

**2012**

Burgess, W.A., Tapriyal, D., Gamwo, I.K., Morreale, B.D., McHugh, M.A., and R.M. Enick, "Viscosity models based on the free volume and frictional theories for systems at pressures to 276 MPa and temperatures to 533 K," Industrial & Engineering Chemistry Research, **51**, 16721-16733 (2012).

Bamgbade, B., Wu Y., Burgess, W., and M.A. McHugh, "Experimental density and PC-SAFT modeling of Krytox (perfluoropolyether) at pressures to 275 MPa and temperatures to 260 °C," Fluid Phase Equilibria, **332**, 159-164 (2012).

Burgess, W., Tapriyal, D., Baled, H., Enick, R.M., Wu, Y., McHugh, M.A., and B.D. Morreale, "Prediction of fluid densities at extreme conditions using the perturbed-chain SAFT equation correlated to high temperature, high pressure density data," Fluid Phase Equilibria, **319**, 55-66 (2012).

Baled, H., Enick, R.M., Wu, Y., McHugh, M.A., R.M., Burgess, W., Tapriyal, D., and B.D. Morreale, "Prediction of hydrocarbon densities at extreme conditions using volume-translated SRK and PR equations of state fit to high temperature, high pressure *PVT* data," Fluid Phase Equilibria, **317**, 65-76, (2012).

**2011**

Wu, Y., Bamgbade, B. Liu, K., McHugh, M.A., Baled, H., Enick, R.M., Burgess, W., Tapriyal, D., and B.D. Morreale, "Experimental measurements and equation of state modeling of liquid densities for long-chain n-alkanes at pressures to 265 MPa and temperatures to 523 K," Fluid Phase Equilibria, **311**, 17-24 (2011).

**2010**

Liu, K., Wu, Y., McHugh, M.A., Baled, H., Enick, R.M., and B.D. Morreale, “Equation of state modeling of high-pressure, high-temperature hydrocarbon density data,” Journal of Supercritical Fluids, **55**, 701-711 (2010).

Liu, J., Shen, Z., Lee, S.-H., Marquez, M., and M.A. McHugh, “Electrospinning in compressed carbon dioxide: Hollow or open-cell fiber formation with a single nozzle configuration,” Journal of Supercritical Fluids, **53**, 142-150 (2010).

**2009**

Kostko, A.F., Harden, J.L., and M.A. McHugh, “Dynamic light scattering study of concentrated triblock copolymer micellar solutions under pressure,” Macromolecules, **42**, 5328-5338 (2009).

Gorle, B.S.K., Smirnova, I., and M.A. McHugh, “Adsorption and thermal release of highly volatile compounds in silica aerogels,” Journal of Supercritical Fluids, **48**, 85-92 (2009).

**2008**

Kostko, A.F., Lee, S.H., Liu, J., DiNoia, T.P., Kim, Y., and M.A. McHugh, “Cloud-point behavior of poly(ethylene-*co*-20.2 mol%-1-butene) (PEB10) in ethane and deuterated ethane and of deuterated PEB10 in pentane isomer,” Journal of Chemical and Engineering Data, **53**, 1626-1629 (2008).

Liu, J, Li, D., Byun, H.S., and M.A. McHugh, “Impact of fluorine on the phase behavior of bis-p-tolyl propane in supercritical CO2, 1,1-difluoroethane, and 1,1,1,2-tetrafluoroethane,” Fluid Phase Equilibria, **267**, 39-46 (2008).

Shen, Z., Huvard, G.S., Warriner, C.S., McHugh, M.A., Banyasz, J.L., and M.K. Mishra, “CO2-assisted fiber impregnation,” Polymer, **49**, 1579-1586 (2008).

Churchley, D., Barbu, E., Ewen, R.J., Shen, Z., Kim, Y.C., McHugh, M.A., Zhang, Z.Y., Nevell, T.G., Rees, G.D., and J. Tsibouklis, “Synthesis and characterization of low surface energy fluoropolymers as potential barrier coatings in oral care,” Journal of Biomedical Materials Research Part A, **84A**, 994-1005 (2008).

Liu, J., Li, D., Byun, H.S., and M.A. McHugh, “Impact of fluorine on the phase behavior of bisphenol-type compounds in supercritical CO2, 1,1-difluoroethane, and 1,1,1,2-tetrafluoroethane,” Industrial & Engineering Chemistry Research, **47**, 524-529 (2008).

**2007**

Byun, H.-S. and M.A. McHugh,“High pressure phase behavior of poly[isopropyl acrylate] and poly[isopropyl methacrylate] in supercritical fluid (SCF) solvent and SCF solvent + cosolvent mixtures,” Journal of Supercritical Fluids, **41**, 482-491 (2007).

Liu, J., Spraul, B.K., Topping, C., Smith Jr., D.W., and M.A. McHugh, “Effect of hexafluoroisopropylidene on perfluorocyclobutyl aryl ether copolymer solution behavior in supercritical CO2 and propane,” Macromolecules, **40**, 5973-5977 (2007).

**2006**

Shen, Z., Thompson, B.E., and M.A. McHugh, “Electrospinning in near-critical CO2,” Macromolecules, **39**, 8553-8555 (2006).

Shen, Z., Li, D., Kim, Y., and M.A. McHugh, “Solubility of pyrazine and its derivatives in supercritical carbon dioxide,” Journal of Chemical and Engineering Data, **51**, 2056-2064 (2006).

Liu, J., Kim, Y.C., and M.A. McHugh, “Phase behavior of the vanillin-CO2 system at high pressures,” Journal of Supercritical Fluids, **39**, 201-205 (2006).

Liu, J., Kim, Y.C., and M.A. McHugh, “Phase behavior of diisobutyl adipate-carbon dioxide mixtures,” Fluid Phase Equilibria, **248**, 44-49 (2006).

Wright, M.E., Gorish, C.E., Shen, Z., and M.A. McHugh, “2,5-Dichloro-1-(ROSO2)benzene [R = C6H5, C6F5, and CH2(CF2)4H]: Synthesis, molecular structure, and solubility in supercritical CO2,” Journal of Fluorine Chemistry, **127**, 330-336 (2006).

Kostko, A.F., McHugh, M.A., and J.H. van Zanten, “Coil-coil interactions for poly(dimethyl siloxane) in compressible supercritical CO2,” Macromolecules, **39**, 1657-1659 (2006).

**2005**

Shen, Z., Lott, K.M., Wright, M.E., and M.A. McHugh, “Impact of configuration and fluorination on the solubility of octyl ester benzoate dimers in CO2,” Fluid Phase Equilibria, **238**, 210-219 (2005).

DiNoia, T.P., Park, I.-H., McHugh, M.A., and J.H. van Zanten, “Observation of polymer chain contraction near the overlap concentration,” Macromolecules, **38**, 9393-9395 (2005).

Shen, Z., McHugh, M.A., Smith, D.W., Abayashinghe, N.K., and J. Jin, “Impact of hexafluoroisopropylidene on the solubility of aromatic-based polymers in supercritical fluids,” Journal of Applied Polymer Science, **97**, 1736-1743 (2005).

Li, D., McHugh, M.A., and J.H. van Zanten, “Density induced phase separation in poly(ethylene-co-1-butene)-dimethyl ether solutions,” Macromolecules, **38**, 2837-2843 (2005).

**2004**

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**Research Proposals Funded**

Afton Chemical Corporation, “The use of star polymers and dendrimers as viscosity modifiers, dispersants, antioxidants, and detergents,” $319,600 (4/09 - 12/14).

Department of Energy (DOE), “Thermodynamic studies in support of geological and environmental processes at extreme conditions," $720,000 (3/10 - 11/14).

Department of Defense, ONR, "Novel acute rescue strategies using nonpulmonary oxygenation," McHugh current PI as of 9/13, $246,800 current budget 11/12 - 11/13, (Kevin Ward -- original PI until 9/12, Emergency Medicine and Physiology); $161,000 McHugh share of the budget 11/10-11/12.

DOE, Reaction chemistry & engineering support design of experimental apparatus for high pressure PVT research," $44,249 (11/09 - 1/10).

ONR, “Novel acute rescue strategies using nonpulmonary oxygenation,” VCU *co-P.I.s G.S. Huvard (CLSE), E. Carpenter (Chemistry), R. Diegelmann (Biochemistry, Anatomy, & Emergency Medicine), and K. Ward (PI, Emergency Medicine and Physiology)*, $1,923,966 ($759,645 was split between McHugh and Huvard) (1/07-2/11).

DAI-ACT, “Processing fluoropolymers with supercritical fluid solvents,” $1,088,318 (9/01-6/09).

General Atomics, “Smart Microsenor Arrays,” *co-P.I. Huvard at VCU from 3/08 to 5/08*, $216,000 (3/08 - 2/09).

VCU Center for Teaching Excellence, “Development of student computational skills for Thermodynamics,” $3,500, *co-P.I. Fong at VCU* (2006)

American Chemical Society (PRF), “Dynamic light scattering studies of polymer-supercritical fluid mixtures,” $80,000 (6/03-6/06).

Philip Morris, “Supercritical fluid assisted encapsulation studies,” $245,125 (4/03-6/05).

Philip Morris, “Supercritical carbon dioxide assisted electrospinning of polymeric materials for cigarette filter applications” -- *co-PIs: Wnek, Huvard, and Haas at VCU*, $156,576 (1/03-12/03).

Powerspan Inc., “Hydrogen systems at high pressures,” $1,500 (8/01).

Nova Corporation, “Kinetics of phase transitions at high pressures,” Unrestricted Grant, $39,000 (3/01).

Argonne National Laboratories, “High-pressure neutron scattering studies of polymers dissolved in compressible liquid solvents,” four days of neutron beam time, March and August 2001 with *co-P.I. J.H. van Zanten at NC State University* -- there is no monetary award to this peer-reviewed proposal.

Sentor Technologies, Inc., “Development of an automated precision coating system for SAW-based chemical sensors,” $30,000 (7/01-1/02) *co-PI* *Gary Tepper at VCU*.

NIST Center for Neutron Research, “SANS on polymer-supercritical fluid mixtures,” four days of neutron beam time, November 1999, March 2000, June 2000, and June 2001 with *co-P.I. J.H. van Zanten at N.C. State University* -- there is no monetary award to this peer-reviewed proposal.

Maryland Industrial Partnerships Award, “Thin Film Development,” $71,225 (9/99-8/00).

E.I. DuPont de Nemours & Co., “Solubility behavior of ethylene copolymers at high pressures,” $857,000 (1/91-12/00).

Shinko Research Corporation, “Polymer-CO2 phase behavior,” Unrestricted Grant, $24,500 (7/00).

NSF, “Microscopic basis of polymer-supercritical fluid phase behavior: Effect of polymer-solvent interactions and chain stiffness,” $346,140 (3/98-8/01) with *co-P.I J.H. van Zanten at N.C. State University*.

Nova Corporation, “Polymer-solvent phase behavior,” $160,000 (7/98-6/00).

NSF Graduate Research Fellowship, Thomas Kermis, $73,500, 6/97-5/00.

NSF, “An integrative research and teaching doctoral program in environmentally conscious chemical processing,” $562,500 (9/95-9/00), (McHugh share was $225,000) *co-P.I.s T.A. Barbari and M.D. Donohue both at JHU*).

E.I. DuPont de Nemours & Co., DuPont Educational Aid Program, Unrestricted Grants, $75,000 (6/94-6/99).

Ferro Corporation, “Materials processing in CO2,” Unrestricted Grant, $95,000 (5/97-12/99).

ACS-PRF AC, “Polymer structures in supercritical fluids,” $50,000, 9/97-8/99.

Los Alamos National Laboratory, “CO2 studies,” $55,000 (7/1/97-10/31/97), *co-PI* *M.E. Paulaitis at JHU*.

Shinko Research Corporation, “Polymer-CO2 phase behavior,” Unrestricted Grant, $16,200 (7/97).

Nova Corporation, “Polymer-solvent phase behavior,” Unrestricted Grant, $29,000 (9/97).

US Army Research Laboratory, “Experimental studies to assess the feasibility of using supercritical fluid solvents to process energetic materials in an environmentally benign manner,” $9,000 (11/96-7/97).

US Army Research Laboratory, “Modeling of Triple-Base Gun Propellant Ingredients in Supercritical Fluids,” $26,286 (5/97-10/97), (my share of a $30,000 grant with *co-P.I. J. Cocchiaro @CPIA*).

NSF, “Experimental study of high pressure copolymer solution behavior,” $422,439 (2/92-9/97).

US Army Research Laboratory, “Experimental studies to assess the feasibility of using supercritical fluid solvents to process energetic materials in an environmentally benign manner,” $47,000, (9/95-12/95).

NSF, “SGER: “Conversion/recycling of ethylene-based copolymers: Is it feasible in SCF-water mixtures,” $43,099 (4/95-3/96).

Naval Surface Warfare Center, “High-pressure experimental solubility studies” $6,243 (3/95-8/95).

NSF, “Research experience for undergraduates,” $6,500 (8/92-7/95)

Sogang University, Seoul, Korea, “Supercritical drying process optimization of superinsulating aerogels,” $60,000 (10/92-12/94).

E.I. DuPont de Nemours & Co., “Fluorocopolymer-SCF solubility behavior,” Unrestricted Grant, $60,000 (6/93).

E.I. DuPont de Nemours & Co., 1993-94 DuPont Educational Aid Program, Unrestricted Grant, $10,000 (5/93).

NSF, “Polymer surfaces for sustained cell growth: Development and study of molecular interactions,” $119,934, 9/88-8/91, (my share of a $600,000 grant with *co-P.I.s W.M. Saltzman, K. Leong, and S. Lin at JHU*).

Korea Institute of Energy and Resources, “Phase behavior studies,” $29,500 (8/90-7/91).

NSF, “Electrodeposition from nonaqueous supercritical electrolyte solutions,” $50,000, *co-P.I. G.A. Prentice at JHU* (2/90-1/91).

NSF, “Free-radical reactions in supercritical fluids,” $123,963 (4/87-4/89).

Aristech Chemical Company, “Polymer solubility and modeling,” $30,000 (7/87-7/88).

NSF, “Phase behavior of supercritical fluids for use in electroorganic synthesis,” $30,000, *co-P.I. G.A. Prentice at JHU* (9/86-12/87).

Exxon Chemical Company, “Supercritical extraction of alcohols,” $7,500 (7/87).

ONR, “Thermodynamics of polymer-supercritical solvent mixtures,” $359,368 (7/83-9/88).

Battelle Memorial Institute, “Unrestricted research award,” $60,000 (10/84-9/86).

Koppers Company, “Reactions in supercritical fluid solvents,” $248,134 (9/82-9/86).

Exxon Chemical Company, “High-pressure thermodynamics,” $230,817 (10/81-6/85).

NSF, “Experimental investigation of the high-pressure fluid phase behavior of solid polymer-supercritical solvent mixtures,” $58,526 (4/82-4/84).

Air Products and Chemicals, Unrestricted research award, $5,000 (2/83).

University of Notre Dame Research Fund, “High-pressure studies of polymer-supercritical fluid systems,” $2,979 (4/81-5/82).

**Selected List of Services at Virginia Commonwealth University**

VCU, University Committees

University Undergraduate Curriculum Council, Fall 2010-Spring 2013

University Graduate Council, Fall 2001-Spring 2004

University Graduate Council: Programs and Courses Committee, Fall 2001-Spring 2004

School of Engineering, Dean Search Committee, Fall 2005-Spring 2006

VCU, School of Engineering Committees

School Grievance Committee, Alternate, Fall 2010-Fall 2012

Qimonda Professorship Committee, Fall 2007-Spring 2009

Community Partnerships and Research, subcommittee of the VCU Strategic Planning Committee, Fall 2004

Graduate Appeals Panel, Fall 2004-present

Faculty Council, Spring 2004-Spring 2010

Promotion & Tenure Policy Review Committee, Fall 2008-Spring 2010

Promotion & Tenure Committee, Fall 2005-Spring 2010, Fall 2000-Spring 2003, Chair Fall 2001- Spring 2001

Selection Committee for the VCU Distinguished Faculty Awards Program, April 2006

Graduate Operations Committee, Chair, Fall 2000-Spring 2001

Graduate Course Committee, Fall 2000- Spring 2001

VCU, Departmental Committees

Faculty Search Committee, Fall 1999-Spring 2005; Spring 2007-Fall 2007

Graduate Program Committee, Fall 1999-Fall 2000

**Selected List of Services at Johns Hopkins University** (1985-1999)

JHU, University Committees

Graduate Board, 1998-1999 (Requested to serve consecutive terms) 1995-1998; 1989-1992; Engineering Dean Search Committee, 1991-1992

Undergraduate Ethics Board, 1987-1990

Graduate Board Oral Examination Committee, 1987-1999

JHU, College Committees

Subcommittee on Research, Whiting School Strategic Planning Committee, S92

Engineering Faculty Assembly Committee, F91-S93, Secretary, F91-F92

Whiting School Anniversary Committee, S88-S89

Montgomery County Research Committee, S86

Advisory Board for the Professional Development Program, 1987-1989

JHU, Departmental Committees

Faculty Hiring Committee, 3/96 - 9/99

Graduate Program: Studies, 7/87-9/99; Admissions, 7/85-6/92; Examination, 1/89-5/92; Policy, 9/90-5/92; Brochure, 6/85-1/91

Administrative Assistant Search Committee, 12/96 - 3/97

Seminar Committee, 7/89-5/90

Faculty Advisor: 2002 Class (27 students) w/Professor Hanes; 1997 Class (15 students); 1996 Class (19 students); 1989 Class (14 students)

Faculty/Student Interaction Program, F90; S88; F86

**Selected List of Services at the University of Notre Dame,** (1981-1985)

ND, College Committees

Graduate Studies, 9/81-9/84

ND, Departmental Committees

Graduate Program: Studies & Research, 1/81-9/84

Director of Graduate Program, 6/81-6/82

Recruiting, 9/81-9/84

Chair Search Committee, 6/81-12/82

Alumni & Public Relations, 7/82-9/84