

CURRICULUM VITAE
ABRAHAM M. LENHOFF

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Education: B.Sc. (Eng.) in Chemical Engineering (with first-class honors), University of Cape Town, 1976.

 M.S. in Chemical Engineering, University of Wisconsin-Madison, 1979.
 Thesis (under Prof. M. Morari): The Design of Integrated Processing Systems with Consideration of Dynamic Behaviour.

 Ph.D. in Chemical Engineering, University of Wisconsin-Madison, 1984.
 Thesis (under Prof. E. N. Lightfoot): Convective Dispersion and Interphase Mass Transfer.

Research interests:

Applied protein biophysics and bioengineering, thermodynamics and transport phenomena, separations processes, colloid and interface science.

Professional experience:

2012-2017	Chair, Department of Chemical and Biomolecular Engineering, University of Delaware
9-12/2010	Olaf A. Hougen Visiting Professor, Department of Chemical and Biological Engineering, University of Wisconsin
2010-	Allan P. Colburn Professor of Chemical Engineering, University of Delaware
2005-2015	Director, NIH Center of Biomedical Research Excellence on Membrane Protein Production and Characterization, University of Delaware
2002-2010	Gore Professor of Chemical Engineering, University of Delaware
2000-2005	Director, NIH Center of Biomedical Research Excellence in Structural and Functional Genomics, University of Delaware
1996-	Professor, Department of Chemical Engineering, University of Delaware
1990-1996	Associate Professor, Department of Chemical Engineering, University of Delaware
12/1994-5/1995	Visiting Research Fellow, Departments of Chemistry and Chemical Engineering, University of Melbourne, Australia
7-8/1990	Visiting Professor, Department of Chemical Engineering, University of Cape Town, South Africa
1984-1990	Assistant Professor, Department of Chemical Engineering, University of Delaware

6-8/1985 Research Fellow, Institut für Anorganische Chemie and Analytische Chemie, Johannes-Gutenberg Universität, Mainz, Germany

1980 Junior Lecturer, Department of Chemical Engineering, University of Cape Town, South Africa

Honors:

1974-1976 D. N. Malan Medals in Chemical Engineering
 1975-1976 Cape Town Corporation Medals in Engineering
 1976 S. A. Institution of Chemical Engineers Medal
 1985 Research Fellowship, Alexander von Humboldt-Stiftung
 1987 NSF Presidential Young Investigator Award
 1991 College of Engineering Special Faculty Award
 2000 Weissberger-Williams Lecturer, Eastman Kodak Co.
 2002 Gore Professorship in Chemical Engineering
 2003 Fellow, American Institute for Medical and Biological Engineering
 2003 Fellow, American Association for the Advancement of Science
 2009 American Chemical Society Award in Separations Science and Technology
 2009 Alan S. Michaels Award in the Recovery of Biological Products
 2009 College of Engineering Excellence in Teaching Award
 2010 Allan P. Colburn Professorship in Chemical Engineering
 2010 Olaf A. Hougen Visiting Professorship, University of Wisconsin
 2011 Marvin J. Johnson Award in Microbial and Biochemical Technology
 2014 Francis Alison Award, University of Delaware
 2017 Hess Lecturer, University of Virginia
 2025 Food, Pharmaceutical and Bioengineering Division Award, AIChE

Professional activities:

American Institute of Chemical Engineers
 American Association for the Advancement of Science
 American Chemical Society
 American Crystallographic Association
 Biophysical Society
 Associate Editor, *AIChE Journal* (2005-2012)
 Editorial Board, *Journal of Pharmaceutical Sciences* (1994-1996)
 Editorial Board, *Journal of Colloid and Interface Science* (2001-2004)
 Editorial Board, *Biotechnology and Bioengineering* (2003-)
 Member-at-Large of Council, Gordon Research Conferences (2006-2008)
 Member, BRT-B Study Section, NIH-NIGMS (2007-2011)
 Member, Scientific Committee, Intl. Symposium on Preparative and Process Chromatography (PREP) (2011-)
 Member, Advisory Board, *Chemical & Engineering News* (2012-2015)
 Member, Governing Board, Council for Chemical Research (2012-2015)
 Conference Co-Chair, Biopartitioning and Purification (BPP) (2013)
 Member, Visiting Committee, Department of Chemical and Biological Engineering, University of Wisconsin (2011-2017)
 Member, External Advisory Board, Accelerated Innovation in Manufacturing Biologics (AIM-Bio), NC State University (2020-)

Conference Co-Chair, Recovery of Biological Products XX (2024)
Member, Recovery of Biological Products Conferences Board (2022-)
Member, Organizing Committee, Neutrons and Food 7 (2024)
Member, Executive Committee, Chromatography Forum of Delaware
Valley (2025-2028)

Patents

Lee, K., A. Lenhoff, K. Valente, N. Levy and Y. Gokarn, "Reduction of Lipase Activity in Product Formulations", US Patent 9,932,591 (2018); 10,570,397 (2020).

Publications in refereed journals (> 12500 citations, h-index 60, Web of Science, Dec 2025)

1. Lenhoff, A. M., and M. Morari, "Design of Resilient Processing Plants. I. Process Design Under Consideration of Dynamic Aspects", *Chem. Eng. Sci.* **37**, 245-258 (1982).
2. Lightfoot, E. N., A. M. Lenhoff and R. L. Rodriguez, "Use of Moments to Characterize Mass Transport in Steady Flows of Arbitrary Complexity", *Chem. Eng. Sci.* **37**, 954-956 (1982).
3. Lenhoff, A. M., and E. N. Lightfoot, "The Effects of Axial Diffusion and Permeability Barriers on the Transient Response of Tissue Cylinders. I. Solution in Transform Space", *J. Theor. Biol.* **97**, 663-677 (1982).
4. Lenhoff, A. M., and E. N. Lightfoot, "The Effects of Axial Diffusion and Permeability Barriers on the Transient Response of Tissue Cylinders. II. Solution in Time Domain", *J. Theor. Biol.* **106**, 207-238 (1984).
5. Lenhoff, A. M., "Computation of the Eigenvalues of a Class of Non-Self-Adjoint Operators", *SIAM J. on Appl. Math.* **45**, 360-368 (1985).
6. Lightfoot, E. N., R. F. Rudolph, A. M. Lenhoff, E. H. Lanphier, C. E. Lehner and L. A. Whiteside, "Hydrogen Washout in Bone Cortex and Periosteum", *Undersea Biomed. Res.* **13**, 425-441 (1985).
7. Lenhoff, A. M., and E. N. Lightfoot, "Convective Dispersion and Interphase Mass Transfer", *Chem. Eng. Sci.* **41**, 2795-2810 (1986).
8. Lenhoff, A. M., "Significance and Estimation of Chromatographic Parameters", *J. Chrom.* **384**, 285-299 (1987).
9. Daskopoulos, P., and A. M. Lenhoff, "Dispersion Coefficient for Laminar Flow in Curved Tubes", *AIChE J.*, **34**, 2052-2058 (1988).
10. Daskopoulos, P., and A. M. Lenhoff, "Flow in Curved Ducts: Bifurcation Structure for Stationary Ducts", *J. Fluid Mech.*, **203**, 125-148 (1989).
11. Boedeker, A. R., and A. M. Lenhoff, "Affinity Separations using Liquid Perfluorocarbon Supports: Rate Effects", *Biotech. Prog.*, **5**, 132-135 (1989).
12. Shankar, A., and A. M. Lenhoff, "Dispersion in Laminar Flow in Short Tubes", *AIChE J.*, **35**, 2048-2052 (1989).

13. LaMarca, C., A. M. Lenhoff and P. Dhurjati, "Partitioning of Host and Recombinant Cells in Aqueous Two-Phase Polymer Systems", *Biotech. Bioeng.*, **36**, 484-492 (1990).
14. Daskopoulos, P., and A. M. Lenhoff, "Flow in Curved Ducts. Part 2. Rotating Ducts", *J. Fluid Mech.*, **217**, 575-593 (1990).
15. Yoon, B. J., and A. M. Lenhoff, "A Boundary Element Method for Molecular Electrostatics with Electrolyte Effects", *J. Comput. Chem.*, **11**, 1080-1086 (1990).
16. Haggerty, L., and A. M. Lenhoff, "Relation of Protein Electrostatics Computations to Ion Exchange and Electrophoretic Behavior", *J. Phys. Chem.*, **95**, 1472-1477 (1991).
17. Haggerty, L., B. A. Watson, M. A. Barteau and A. M. Lenhoff, "Ordered Arrays of Proteins on Graphite Observed by Scanning Tunneling Microscopy", *J. Vac. Sci. Tech. B*, **9**, 1219-1222 (1991).
18. Shankar, A., and A. M. Lenhoff, "Dispersion and Partitioning in Short Coated Tubes", *Ind. Eng. Chem. Res.*, **30**, 828-835 (1991).
19. Daskopoulos, P., and A. M. Lenhoff, "Modelling of Particle Separations in Complex Flows", *Sep. Sci. Tech.*, **26**, 1013-1050 (1991).
20. Shankar, A., and A. M. Lenhoff, "Dispersion in Round Tubes and Its Implications for Extra-Column Dispersion", *J. Chrom.*, **556**, 235-248 (1991).
21. Shibata, C. T., and A. M. Lenhoff, "TIRF of Salt and Surface Effects on Protein Adsorption: I. Equilibrium", *J. Coll. Interf. Sci.*, **148**, 469-484 (1992).
22. Shibata, C. T., and A. M. Lenhoff, "TIRF of Salt and Surface Effects on Protein Adsorption: II. Kinetics", *J. Coll. Interf. Sci.*, **148**, 485-507 (1992).
23. Yoon, B. J., and A. M. Lenhoff, "Computation of the Electrostatic Interaction Energy between a Protein and a Charged Surface", *J. Phys. Chem.*, **96**, 3130-3134 (1992).
24. Watson, B. A., M. A. Barteau, L. Haggerty, A. M. Lenhoff and R. S. Weber, "Scanning Tunneling Microscopy and Tunneling Spectroscopy of Ordered Hetero- and Isopolyanion Arrays on Graphite", *Langmuir*, **8**, 1145-1148 (1992).
25. Haggerty, L., and A. M. Lenhoff, "STM and AFM in Biotechnology", *Biotech. Prog.*, **9**, 1-11 (1993).
26. Haggerty, L., and A. M. Lenhoff, "Analysis of Ordered Arrays of Adsorbed Lysozyme by Scanning Tunneling Microscopy", *Biophys. J.*, **64**, 886-895 (1993).
27. Roth, C. M., and A. M. Lenhoff, "Electrostatic and van der Waals Contributions to Protein Adsorption: Computation of Equilibrium Constants", *Langmuir*, **9**, 962-972 (1993).
28. Richards, J. R., A. N. Beris and A. M. Lenhoff, "Steady Laminar Flow of Liquid-Liquid Jets at High Reynolds Numbers", *Phys. Fluids A*, **5**, 1703-1717 (1993).
29. Schure, M. R., and A. M. Lenhoff, "Consequences of Wall Adsorption in Capillary Electrophoresis: Theory and Simulation", *Anal. Chem.*, **65**, 3024-3037 (1993).
30. Palkar, S. A., and A. M. Lenhoff, "Energetic and Entropic Contributions to the Interaction of Unequal Spherical Double Layers", *J. Coll. Interf. Sci.*, **165**, 177-194 (1994).

31. Lenhoff, A. M., "Contributions of Surface Features to the Electrostatic Properties of Rough Colloidal Particles", *Colloids Surf. A*, **87**, 49-59 (1994).
32. Johnson, C. A., P. Wu and A. M. Lenhoff, "Electrostatic and van der Waals Contributions to Protein Adsorption: 2. Modelling of Ordered Arrays", *Langmuir*, **10**, 3705-3713 (1994).
33. Richards, J. R., A. M. Lenhoff and A. N. Beris, "Dynamic Breakup of Liquid-Liquid Jets", *Phys. Fluids*, **6**, 2640-2655 (1994).
34. Chae, K. S., and A. M. Lenhoff, "Computation of the Electrophoretic Mobility of Proteins", *Biophys. J.*, **68**, 1120-1127 (1995).
35. Pjura, P. E., M. E. Paulaitis and A. M. Lenhoff, "Molecular Thermodynamic Properties of Protein Solutions from Partial Specific Volumes", *AIChE J.*, **41**, 1005-1009 (1995).
36. Neal, B. L., and A. M. Lenhoff, "Excluded Volume Contribution to the Osmotic Second Virial Coefficient for Proteins", *AIChE J.*, **41**, 1010-1014 (1995).
37. Richards, J. R., A. N. Beris and A. M. Lenhoff, "Drop Formation in Liquid-Liquid Systems Before and After Jetting", *Phys. Fluids*, **7**, 2617-2630 (1995).
38. Roth, C. M., and A. M. Lenhoff, "Electrostatic and van der Waals Contributions to Protein Adsorption: Comparison of Theory and Experiment", *Langmuir*, **11**, 3500-3509 (1995).
39. Palkar, S. A., and A. M. Lenhoff, "Effect of Taper on Diffusion and Adsorption in a Cylindrical Pore", *Ind. Eng. Chem. Res.*, **34**, 3551-3555 (1995).
40. Roth, C. M., B. L. Neal and A. M. Lenhoff, "Van der Waals Interactions Involving Proteins", *Biophys. J.*, **70**, 977-987 (1996).
41. Roth, C. M., K. K. Unger and A. M. Lenhoff, "A Mechanistic Model of Retention in Protein Ion-Exchange Chromatography", *J. Chrom. A*, **726**, 45-56 (1996).
42. Palkar, S. A., and A. M. Lenhoff, "Diffusion and Adsorption of Proteins in a Model Pore in the Surface Forces Apparatus", *Colloids Surf. A*, **110**, 119-127 (1996).
43. Johnson, C. A., and A. M. Lenhoff, "Adsorption of Charged Latex Particles on Mica Studied by Atomic Force Microscopy", *J. Coll. Interf. Sci.*, **179**, 587-599 (1996).
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45. Lenhoff, A. M., P. E. Pjura, J. G. Dilmore and T. S. Godlewski, Jr., "Ultracentrifugal Crystallization of Proteins: Transport - Kinetic Modelling, and Experimental Behavior of Catalase", *J. Cryst. Growth*, **180**, 113-126 (1997).
46. Oberholzer, M. R., J. M. Stankovich, S. L. Carnie, D. Y. Chan and A. M. Lenhoff, "2-D and 3-D Interactions in Random Sequential Adsorption of Charged Particles", *J. Coll. Interf. Sci.*, **194**, 138-153 (1997).
47. Velev, O. D., T. A. Jede, R. F. Lobo and A. M. Lenhoff, "Porous Silica via Colloidal Crystallization", *Nature*, **389**, 447-448 (1997).

48. Asthagiri, D., and A. M. Lenhoff, "Influence of Structural Details in Modeling Electrostatically Driven Protein Adsorption", *Langmuir*, **13**, 6761-6768 (1997).
49. Oberholzer, M. R., N. J. Wagner and A. M. Lenhoff, "Grand Canonical Brownian Dynamics Simulation of Colloidal Adsorption", *J. Chem. Phys.*, **107**, 9157-9167 (1997).
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57. Yuan, Y., and A. M. Lenhoff, "Characterization of Phase Separation in Mixed Surfactant Films by Liquid Tapping Mode AFM", *Langmuir*, **15**, 3021-3025 (1999).
58. Asthagiri, D., B. L. Neal and A. M. Lenhoff, "Calculation of Short-Range Interactions between Proteins", *Biophys. Chem.*, **78**, 219-231 (1999).
59. Oberholzer, M. R., and A. M. Lenhoff, "Protein Adsorption Isotherms through Colloidal Energetics", *Langmuir*, **15**, 3905-3914 (1999).
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61. Velev, O. D., P. M. Tessier, A. M. Lenhoff and E. W. Kaler, "Nanostructured Photonic Metal Synthesized via Colloidal Crystal Templates", *Nature*, **401**, 548 (1999).
62. Velev, O. D., E. W. Kaler and A. M. Lenhoff, "Photochemical Micromachining of Lysozyme Crystals", *Adv. Matls.*, **11**, 1345-1349 (1999).
63. Johnson, C. A., Y. Yuan and A. M. Lenhoff, "Adsorbed Layers of Ferritin at Solid and Fluid Interfaces Studied by Atomic Force Microscopy", *J. Coll. Interf. Sci.*, **223**, 261-272 (2000).
64. DePhillips, P., and A. M. Lenhoff, "Pore Size Distributions of Cation Exchange Adsorbents Determined by Inverse Size-Exclusion Chromatography", *J. Chrom. A*, **883**, 39-54 (2000).

65. Asthagiri, D., A. M. Lenhoff and D. T. Gallagher, "Role of Competitive Interactions in Growth Rate Trends of Subtilisin s88 Crystals", *J. Cryst. Growth*, **212**, 543-554 (2000).
66. Ruppert, S., S. I. Sandler and A. M. Lenhoff, "Correlation between the Second Osmotic Virial Coefficient and the Solubility of Proteins", *Biotech. Prog.*, **17**, 182-187 (2001).
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68. Chang, R. C., D. Asthagiri and A. M. Lenhoff, "Measured and Calculated Effects of Mutations in Bacteriophage T4 Lysozyme on Interactions in Solution", *Proteins: Struct. Func. Gen.*, **41**, 123-132 (2000).
69. Pjura, P. E., A. M. Lenhoff, S. A. Leonard and A. P. Gittis, "Protein Crystallization by Design: Chymotrypsinogen without Precipitants", *J. Mol. Biol.*, **300**, 235-239 (2000).
70. Velev, O. D., A. M. Lenhoff and E. W. Kaler, "A Class of Microstructured Particles via Colloidal Crystallization", *Science*, **287**, 2240-2243 (2000).
71. Velev, O. D., E. W. Kaler and A. M. Lenhoff, "Surfactant Diffusion into Lysozyme Crystal Matrices Investigated by Quantitative Fluorescence Microscopy", *J. Phys. Chem. B*, **104**, 9267-9275 (2000).
72. DePhillips, P., and A. M. Lenhoff, "Determinants of Protein Retention Characteristics on Cation Exchange Adsorbents", *J. Chrom. A*, **933**, 57-72 (2001).
73. Asthagiri, D., M. R. Schure and A. M. Lenhoff, "Calculation of Hydration Effects in the Binding of Anionic Ligands to Basic Proteins", *J. Phys. Chem. B*, **104**, 8753-8761 (2000).
74. Velev, O. D., and A. M. Lenhoff, "Colloidal Crystals as Templates for Porous Materials", *Curr. Opinion Coll. Interf. Sci.*, **5**, 56-63 (2000).
75. Hloucha, M., J. F. M. Lodge, A. M. Lenhoff and S. I. Sandler, "A Patch-Antipatch Representation of Specific Protein Interactions", *J. Cryst. Growth*, **232**, 195-203 (2001).
76. Tessier, P. M., O. D. Velev, A. T. Kalamur, J. F. Rabolt, A. M. Lenhoff and E. W. Kaler, "Assembly of Gold Nanostructured Films Templated by Colloidal Crystals and Use in Surface-Enhanced Raman Spectroscopy", *J. Amer. Chem. Soc.*, **122**, 9554-9555 (2000).
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- Screening of Osmotic Second Virial Coefficients", *Proteins: Struct. Func. Gen.*, **50**, 303-311 (2003).
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 85. Yuan, Y., O. D. Velev and A. M. Lenhoff, "Mobility of Adsorbed Proteins Studied by Fluorescence Recovery after Photobleaching", *Langmuir*, **19**, 3705-3711 (2003).
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95. Yao, Y., and A. M. Lenhoff, "Determination of Pore Size Distributions of Porous Chromatographic Adsorbents by Inverse Size Exclusion Chromatography", *J. Chrom. A*, **1037**, 273-282 (2004). Erratum: *J. Chrom. A*, **1113**, 259 (2006).
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102. Yao, Y., and A. M. Lenhoff, "Electrostatic Contributions to Protein Retention in Ion-Exchange Chromatography. II. Proteins with Various Degrees of Structural Differences", *Anal. Chem.*, **77**, 2157-2165 (2005).
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209. López Ruiz, A., E. Slaughter, K. Bomb, P. LeValley, Z. Yun, J. McCoskey, K. Levine, J. Steen, J. Almasian, A. Chatterjee, C. Carbrello, D. Chang, A. Fuseini, Y. Abassi, A. Lenhoff, C. Fromen and A. Kloxin, "Bio-Functional Hydrogel Coated Membranes to Decrease T-Cell Exhaustion in Manufacturing of CAR T-Cells", *Front. Immunol.*, **16**, 1513148 (2025).
210. Paul, B., E. M. Furst, A. M. Lenhoff, E. P. Gilbert, N. J. Wagner and S. C. M. Teixeira, "Influence of Pressure Holding Time on Ovalbumin Solution Behavior via Small-Angle Neutron Scattering and Diffusing Wave Spectroscopy", *J. Food Proc. Engg.*, **48**, e70088 (2025).
211. Valiya Parambathu, A., D. J. Rosenman, S. Yadav and A. M. Lenhoff, "Molecular Origins of High Viscosity in Concentrated Solutions of Monoclonal Antibodies", *Biophys. J.*, **124**, 3978-3986 (2025).
212. Bhoyar, S., M. Foster and A. M. Lenhoff, "Multi-Component Behavior of Host-Cell Protein and Antibody-Containing Heteroaggregates in Protein A Chromatography", *J. Chrom. A*, **1753**, 465954 (2025).
213. Valiya Parambathu, A., V. Kumar, O. Khanal and A. M. Lenhoff, "Role of Viral Protein Ratio in the Structure and Separation of Empty and Full Adeno-Associated Virus Capsids: A Molecular Dynamics Study", *Molec. Ther. Adv.*, in press (2026).

214. Paul, B., A. M. Lenhoff, S. C. M. Teixeira, N. J. Wagner and E. M. Furst, "High-Pressure Rheology of a Thermoreversible Protein Sol-Gel", *Ind. Eng. Chem. Res.*, **64**, 19470-19483 (2025).
215. LeBarre, J., D. Bhandari, E. Barbieri, Q. Shu, X. Li, D. Chandra, X. Xu, M. Phillips, J. Bill, T. Williams, P. Gilbert, C. Major, D. Roush, S. Cramer, A. Lenhoff, C. Boi, R. Carbonell and S. Menegatti, "Modernizing the Platform Process of Antibody Purification for Enhanced Impurity Clearance", *Separ. Purif. Tech.*, 136113 (2025).

Other publications

1. Lightfoot, E. N., and A. M. Lenhoff, "Microcirculatory Mass Transfer", in *Oxygen Transport to Tissue-VI*, D. Bruley, H. I. Bicher and D. Reneau (eds.), *Adv. Exptl. Med. Biol.*, **180**, 13-33 (1984).
2. Beris, A. N., J. R. Richards and A. M. Lenhoff, "VOF/CSF Methods Applied to Liquid-Liquid Jet Breakup and Drop Dynamics", in *Advances in Multifluid Flows*, Y. Y. Renardy, A. V. Coward, D. T. Papageorgiou and S.-M. Sun (eds.), SIAM Proceedings, SIAM, Philadelphia, pp. 349-367 (1996).
3. Roth, C. M., and A. M. Lenhoff, "Quantitative Modelling of Protein Adsorption", in *Biopolymers at Interfaces*, M. Malmsten (ed.), Surfactant Science Series, **75**, Marcel Dekker, New York, pp. 89-118 (1998).
4. Tessier, P. M., K. Ong, S. D. Christesen, A. M. Lenhoff, E. W. Kaler and O. D. Velev, "Assembly of Gold Nanostructured Films Templated by Colloidal Crystals and Use in Surface-Enhanced Raman Spectroscopy", *Proc. SPIE-Int. Soc. Opt. Eng.*, **4577**, 53-64 (2002).
5. Lenhoff, A. M., "Ion-Exchange Chromatography of Proteins: The Inside Story", *Matls. Today Proc.*, **3**, 3559-3567 (2016).
6. Lenhoff, A. M., and C. E. Herman, "Control of Host-Cell Proteins in Monoclonal-Antibody Bioprocessing: Using Proteomic Analysis to Understand Impurity Clearance and Persistence during Purification", *BioProc. Intl.*, **21**, 34-38 (2023).

Research students graduated

B.Ch.E. (senior thesis)

- Mario N. DiFalco, Jr., "Mass Transfer and Dispersion in Packed Beds" (1986).
William B. Foster, Jr., "Modeling of Capillary Beds" (1986).
Joseph LaDana, "Analysis of Elution Curves" (1986).
Robert S. Huss, "Electrostatic Factors in Ion-Exchange Chromatography of Proteins" (1990).
Mini Batra, "Effect of Adsorption on Enzyme Activity" (1993).
James G. Dilmore, "Crystallization of Proteins in an Ultracentrifuge" (1993).
Jennifer L. Martin, "Modeling of Protein Separation by Ion-Exchange Chromatography" (1993).
Susan B. Schoch, "Streaming Potential Measurements of Surfaces" (1993).
Laura E. Fleck, "The Effects of Protein Mutation on Partial Specific Volume of T4 Lysozyme" (M. Paulaitis, co-advisor) (1995).
Thomas A. Jede, "Ionic Surfactant Effects on the Solubility of Bovine Serum Albumin and Lysozyme" (1998).
Harvey R. Johnson, "The Rational Procedure for Protein Crystallization: A Study of Ribonuclease A" (2001).
Emily B. Belcher, "Characterization of Intraparticle Transport in Chromatographic Media" (2002).
Matthew J. Panzer, "Examination of Protein Transport in Chromatographic Media Using a Shallow Bed Technique" (2002).
Scott Vandrey, "A Rapid and Rational Method for Crystallizing Heme Proteins" (2002).
Gregory A. Barker, "Protein Size and Electrostatic Effects on Adsorption and Transport Properties in Ion-Exchange Particles" (2003).
Jun Jinkoji, "Self-Interaction Nanoparticle Spectroscopy" (2003).
Vincent J. Verruto, "The Effect of Protein Cross-Interactions on Lysozyme Sieving Behavior in Diafiltration of Binary Mixtures" (2003).
Colleen M. Gendron, "Surfactant Solution Properties and Their Impact on Crystallization of Membrane Proteins" (2004).
Roxana Y. Garcia, "Relation of Surfactant Properties to Solubilization of Membrane Proteins" (2004).
Sean F. Maloney, "Characterization of Transport and Adsorption in Ion-Exchange Chromatography" (2005).
Aaron M. Chockla, "Effects of Temperature, pH and Additives on Protein Phase Behavior" (2007).
Craig S. Schneider, "The Effect of Urea on Surfactant Properties and the Relevance to Urea-Induced Protein-Detergent Complex Unfolding" (2007).
Daniel S. Miller, "Phase Behavior of Polymer-Surfactant-Water Systems Relevant to Membrane Protein Crystallization" (2009).
Matthew G. Petroff, "The Effects of Secondary Stationary-Phase Polymers on Adsorption and Transport in Ion-Exchange Chromatography" (2009).
Laura E. Smith, "Pore Formation in Sustained Release Biopharmaceutical PLGA Rods" (N. J. Wagner, co-advisor) (2019).
Julia Hatoum, "Modeling and Analysis of Patient-Specific Cardiovascular Control" (2024).

M.Ch.E.

- Concetta LaMarca, "Partitioning of Host and Recombinant Cells in Aqueous Two-Phase Polymer Systems" (P. Dhurjati, co-advisor) (1986).
- Allyson R. Boedeker, "Rate Processes in Affinity Separations using Liquid-Supported Immunosorbents" (1989).
- Christopher A. Johnson, "Protein Adsorption: Modeling of Ordered Arrays and Observations by Atomic Force Microscopy" (1993).
- Calendula Chang, "Protein Diffusion and Adsorption in Porous Media" (1997).
- Ray C.-H. Chang, "Thermodynamics of Protein Hydration and Protein-Protein Interactions" (1999).
- Jeffrey J. Moretti, "Precipitation and Crystallization of Lysozyme in Ammonium Sulfate Solutions" (S. Sandler, co-advisor) (1999).
- Anurag Sharma, "Modeling Of Protein Retention In Ion-Exchange Chromatography" (1999).
- Jane Z. Bai, "Characterization of Protein Retention and Transport in Anion Exchange Chromatography" (1999).
- Ronald W. Maurer, "Protein Crystallization and Low Ionic Strength Phase Behavior" (S. Sandler, co-advisor) (2009).
- Leigh J. Quang, "Thermodynamic Modeling of Protein Interactions and Phase Behavior" (S. Sandler, co-advisor) (2011).
- Sai Prasad Ganesh, "Gel-Like Behavior in Amorphous Protein Dense Phases: Phase Behavior, Neutron Scattering and Rheology" (N. Wagner, co-advisor) (2019).
- Xutao Shi, "Modeling the Sustained Release of PLGA-Based Drug Delivery Systems with a Physically-Based Sustained Release Model and Pore Space Characterization" (N. Wagner, co-advisor) (2022).
- Tristan Myers, "Mechanistic Modeling of Primary Depth Filtration in Downstream Bioprocessing" (2023).

Ph.D. [most recent employment shown in brackets]

- Phaidon Daskopoulos, "Flow in Separations Processes in Rotating Helically Coiled Tubes" (1989). [Greece]
- Caroline Tjhen Shibata, "Adsorption Kinetics and Isotherms of Proteins on Chromatographic Surfaces: A Total Internal Reflectance Fluorescence Study" (1990). [Jeffan International]
- Ashish Shankar, "Dispersion in Short Tubes with Applications to Liquid Chromatography" (1991). [Deceased]
- Lorie Haggerty, "The Electrostatics of Protein Adsorption: Molecular Computations and Scanning Tunneling Microscopy Images" (1992). [Aspen Technology]
- John R. Richards, "Fluid Mechanics of Liquid-Liquid Systems" (A. Beris, co-advisor) (1994). [DuPont, retired]
- Saurabh Palkar, "A Nano-Scale Study of Hindered Transport and Adsorption of Proteins" (1994). [Deceased]
- Charles M. Roth, "Electrostatic and van der Waals Contributions to Protein Adsorption" (1994). [Rutgers University]
- Christopher A. Johnson, "Adsorption Behavior of Proteins and Colloidal Particles Studied Using Atomic Force Microscopy" (1997). [Kao Corporation]
- Brian L. Neal, "Molecular Thermodynamic Properties of Aqueous Protein Solution" (1997). [Bayer Corp.]

- Matthew R. Oberholzer, "On the Modeling of Protein and Colloid Adsorption" (1998). [AgriMetis]
- Dilipkumar Asthagiri, "Modeling of Protein Interactions in Solution" (1999). [Oak Ridge National Laboratory]
- Yonghui Yuan, "Adsorption and Surface Mobility of Proteins and Colloids" (2000). [WuXi Biologics]
- Eleni Dokou, "Scanning Probe Microscopy Studies of Chemical and Physical Properties of Particulate Systems" (M. Barteau, N. Wagner, co-advisors) (2001). [Vertex Pharmaceuticals]
- Stephen R. Dziennik, "Effects of Ionic Strength and Stationary Phase on Protein Adsorption and Transport in Ion-Exchange Particles" (2002). [CSL Behring]
- Peter D. De Phillips, "Protein Retention on Cation Exchange Adsorbents" (2002). [Merck, retired]
- Peter M. Tessier, "Fundamentals and Applications of Nanoparticle Interactions and Self-Assembly" (S. Sandler, co-advisor) (2003). [University of Michigan]
- Bryan W. Berger, "Protein-Surfactant Solution Thermodynamics: Applications to Integral Membrane Proteins" (E. Kaler, co-advisor) (2005). [University of Virginia]
- Yan Yao, "Relation of Protein Structure and Adsorbent Pore Architecture to Adsorption and Transport in Chromatography" (2005). [Bristol-Myers Squibb]
- C.-S. Brian To, "Protein Retention and Transport in Hydrophobic Interaction Chromatography" (2006). [Gilead Sciences]
- Yu-Chia Cheng, "Effects of Salts on the Phase Behavior of Proteins and Protein Mixtures" (S. Sandler, co-advisor) (2007). [Taiwan]
- André C. Dumetz, "Protein Interactions and Phase Behavior in Aqueous Solutions: Effects of Salt, Polymer, and Organic Additives" (E. Kaler, co-advisor) (2007). [Glaxo SmithKline]
- John F. Langford, Jr., "Effects of Adsorbent Structure and Adsorption on Transport Phenomena in Ion-Exchange Chromatography" (2007). [Process Engineering Associates]
- Mariagabriella Santonicola, "Molecular Self-Assembly and Interactions in Solutions of Membrane Proteins and Surfactants" (E. Kaler, co-advisor) (2007). [Sapienza University, Rome, Italy]
- Carolina L. Bianco, "Role of Nonionic Surfactants in Promoting the Folding and Stability of Integral Membrane Proteins" (E. Kaler, co-advisor) (2008). [Roche Diagnostics, Germany]
- Xuankuo Xu, "Protein Adsorption Isotherms and Their Effects on Transport in Cation-Exchange Chromatography" (2008). [AstraZeneca]
- Egor I. Trilisky, "Stationary and Mobile Phase Selection for Ion-Exchange Chromatography of Viruses" (2009). [Sobi, Switzerland]
- Rachael A. Lewus, "Monoclonal Antibody Interactions and Phase Behavior" (S. Sandler, co-advisor) (2011). [AstraZeneca]
- Brian D. Bowes, "Protein Transport and Adsorption in Polymer-Modified Ion-Exchange Media" (2011). [Eli Lilly]
- Harun Koku, "Microstructure-Based Analysis and Simulation of Flow and Mass Transfer in Chromatographic Stationary Phases" (2011). [Middle East Technical University, Ankara, Turkey]
- Kelley Kearns, "Membrane Protein Purification and Characterization of Protein-Detergent Complexes" (E. Kaler, co-advisor) (2011). [Avitide]

Christopher M. Gillespie, "Protein Solution Thermodynamics: Polymorphic Crystallization, Liquid-Liquid Phase Separation and Osmotic Second Virial Coefficients" (E. Kaler, co-advisor) (2011). [Merck]

Steven J. Traylor, "Novel Approaches to Understand and Predict Multicomponent Protein Sorption and Kinetics in Chromatographic Materials" (2013). [Bristol-Myers Squibb]

Nicholas E. Levy, "Host Cell Protein Impurities and Protein-Protein Interactions in Downstream Purification of Monoclonal Antibodies" (2014). [Janssen Pharmaceuticals]

Kristin N. Valente, "Optimization and Application of Proteomic Methods for Characterization of Host Cell Protein Impurities from Chinese Hamster Ovary Cells" (K. Lee, co-advisor) (2014). [Merck]

James M. Angelo, "Mechanisms Underlying Protein Sorption and Transport Within Polysaccharide-Based Stationary Phases for Ion-Exchange Chromatography" (2016). [MilliporeSigma]

Daniel G. Greene, "The Formation and Structure of Precipitated Protein Phases" (N. Wagner and S. Sandler, co-advisors) (2016). [Amgen]

Stijn H. S. Koshari, "The Microstructure of Dense Protein Systems in Biopharmaceutical Applications" (N. Wagner, co-advisor) (2018). [Glaxo SmithKline]

Ohnmar Khanal, "Characterizing and Leveraging Protein-Surface Interactions and Protein Transport for Separations" (2020). [Spark Therapeutics]

Young Hoon Oh, "Mechanisms of Host-Cell Protein Persistence in Monoclonal Antibody Processing" (2022). [Janssen Pharmaceuticals]

Chase E. Herman, "Multiscale Analysis of Protein Impurity Clearance in Downstream Bioprocessing" (2023). [Glaxo SmithKline]

Soumitra S. Bhoyar, "Multiscale Phenomena in Protein A Chromatography" (2024). [Amgen]

Brian Paul, "Structure, Rheology, and Phase Behavior of Protein Formulations under High Pressure" (E. Furst, S. Teixeira and N. Wagner, co-advisors) (2025). [Gilead Sciences]

Matthew L. Becker, "Biophysical Interactions of Impurities, Drug Substance, and Purification Media in Downstream Bioprocessing" (2025). [Cytiva]

Michelle M. Gee, "Modeling and Analysis of Autonomic Circuits Underlying Closed-Loop Cardiovascular Control to Identify Key Contributors to Individual Variability" (B. A. Ogunnaike and R. Vadigepalli, co-advisors) (2025). [Genentech]

Post-doctoral researchers

Byung J. Yoon (1989-90)

Peiru Wu (1991-2)

Kyung-Sun Chae (1993-4)

Philip E. Pjura (M. Paulaitis, co-advisor) (1993-7)

Ramona Lemque (1995-7)

Orlin D. Velev (E. Kaler, co-advisor) (1996-2001)

J. Felicity M. Lodge (1998-2000)

Matthias Hloucha (S. Sandler, co-advisor) (1999-2000)

Yong Yuan (E. Kaler, O. Velev, co-advisors) (2000-1)

Chen Guo (E. Kaler, O. Velev, co-advisors) (2000-1)

Paul Hinderliter (E. Kaler, O. Velev, co-advisors) (2000-1)

Ying Pan (E. Kaler, co-advisor) (2000-1)

Rajesh Pazhianur (2001-2)

Denis Vivares (E. Kaler, co-advisor) (2003-5)

Jaeoon Chang (S. Sandler, co-advisor) (2004-6)

Cristina Martin (2005-10)
Harvey R. Johnson (2009-10)
Rahul Bhambure (2013-5)
Amit Vaish (2013-5)
David J. Rosenman (2015-6)
Vijesh Kumar (2016-20)
Jing Guo (K. Lee, co-advisor) (2016-8)
Arjun Valiya Parambathu (2022-4)
Sophia Kurdziel (2025-)

Research grants

1. University of Delaware Research Foundation \$11,000 1/15/85-6/30/85
"Liquid Chromatography at High Solute Loadings"
2. NIH Biomedical Research Support Grant \$5,000 6/15/85-3/31/86
"Biochemical Separations by Countercurrent Chromatography"
3. Unidel Foundation (with P. Dhurjati, \$270,000 2/1/86-
M. Paulaitis, S. Sandler and A. Zydney)
"High Technology Separations Equipment in Chemical Engineering"
4. Whitaker Foundation \$129,759 3/1/87-2/28/90
"Dynamics of Protein Interactions with Chromatographic Surfaces"
5. National Science Foundation PYI Award \$312,000 5/1/87-9/30/92
"Fundamentals of Separations Processes"
6. Industrial Matching Funds for 5:
Merck and Co. \$10,000
Rohm and Haas \$5,000
Procter and Gamble \$5,000
7. E. I. du Pont de Nemours and Co. Inc. and \$74,312 8/1/87-7/31/88
Delaware Research Partnership
"Affinity Separations using Liquid-Supported Immunosorbents"
8. National Science Foundation (with M. Paulaitis \$29,832 10/15/89-3/31/91
and M. Yarmush)
"Expedited Research for the Regeneration of Immunosorbents using Elevated Pressures"
9. National Science Foundation \$7,650 12/1/89-11/30/91
Research Experiences for Undergraduates (linked to #5)
10. National Science Foundation (US-Germany \$9,450 2/1/90-1/31/93
International Program, with K. Unger)
"Kinetic Effects in Protein Chromatography"
11. E. I. du Pont de Nemours and Co. Inc. and \$88,000 10/15/90-6/30/92
Delaware Research Partnership (with M. Paulaitis*)
"Accelerated Testing and Prediction of Freon Permeabilities in Polymeric Materials"
12. National Science Foundation \$4,000 6/15/91-3/31/92
Research Experiences for Undergraduates (linked to #8)
13. National Science Foundation (with E. Kaler) \$161,382 9/1/91-2/28/94
"Relation of Protein Electrostatic Properties to Separations Behavior"

- | | | | |
|-----|---|-------------|------------------|
| 14. | National Aeronautics and Space Administration | \$205,692 | 1/1/92-12/31/93 |
| | "Formation of Ordered Arrays of Proteins on Solid Surfaces" | | |
| 15. | Unidel Foundation (with M. Barteau,
P. Dhurjati, E. Kaler and M. Klein) | \$300,000 | 1/3/92- |
| | "Chemical Engineering and the Environment: Advanced Instrumentation Requirements" | | |
| 16. | Department of Energy (with M. Barteau) | \$111,240 | 8/1/92-7/31/93 |
| | "Synthesis, Characterization and Reactivity of Uniform Surfaces with Complex Chemical Functions" | | |
| 17. | National Science Foundation (with M. Paulaitis,
E. Kaler and S. Sandler) | \$765,026 | 9/15/92-8/31/95 |
| | "Protein Separations: A Thermodynamic Approach" | | |
| 18. | National Science Foundation | \$9,375 | 9/15/92-2/28/94 |
| | Research Experiences for Undergraduates (linked to #17) | | |
| 19. | Dow Chemical and Delaware Research Partnership
(with M. E. Paulaitis, N. J. Wagner and R. H. Wood) | \$100,000 | 4/1/94-6/30/95 |
| | "The Prediction of Ion Solvation and Mobilities in Hydrated Polymer Membranes from Molecular Simulations" | | |
| 20. | National Aeronautics and Space Administration | \$97,000 | 4/15/94-4/15/95 |
| | "Formation of Ordered Arrays of Proteins on Surfaces" | | |
| 21. | National Science Foundation | \$225,891 | 7/15/94-6/30/97 |
| | "Molecular Biophysics of Protein Adsorption in Ion-Exchange Chromatography" | | |
| 22. | National Science Foundation | \$16,750 | 7/15/94-2/29/96 |
| | International travel supplement to #21 | | |
| 23. | Mobil Research and Development Corp. | \$117,000 | 12/1/94-11/30/96 |
| | "The Application of M41S as Bioseparations Media" | | |
| 24. | Mobil Research and Development Corp. and
Delaware Research Partnership | \$119,000 | 12/1/94-11/30/96 |
| | "Pore Size Effects on Bioseparations" | | |
| 25. | National Science Foundation (with M. Paulaitis,
E. Kaler and S. Sandler) | \$1,060,556 | 3/1/96-2/28/2000 |
| | "The Thermodynamics of Protein Separations" | | |
| 26. | National Aeronautics and Space Administration
(with M. Barteau, N. Wagner) | \$120,000 | 4/25/96-4/24/99 |
| | "Molecularly Tailored Surfaces via Self-Assembly Processes: Synthesis, Characterization and Modeling" | | |

- | | | | |
|-----|---|--------------|-----------------|
| 27. | Novo Nordisk and Delaware Research Partnership
"Relation of Stationary-Phase Structure to Chromatographic Performance: New Approaches to Design of Protein Separation Processes and Media" | \$30,000 | 5/27/98-5/28/99 |
| 28. | Kraft Foods
(with E. Kaler and O. Velev)
"Interaction between Soybean Protein Components in Relation to Their Macroscopic Properties" | \$75,000 | 1/16/99-1/15/00 |
| 29. | National Aeronautics and Space Administration
(with E. Kaler)
"Protein Crystallization in Complex Fluids" | \$612,396 | 7/1/97-6/30/01 |
| 30. | Merck and Delaware Research Partnership
"Chromatography of Viruses and Plasmids" | \$108,000 | 5/15/99-5/14/00 |
| 31. | National Science Foundation
"Fundamentals of Retention and Transport in Protein Ion-Exchange Chromatography" | \$249,999 | 8/1/99-7/31/03 |
| 32. | National Institutes of Health
(with 6 junior co-investigators)
"COBRE: Structural and Functional Genomics" | \$7,017,902 | 9/30/00-9/30/05 |
| 33. | National Science Foundation (with M. Paulaitis,
E. Kaler and S. Sandler)
"The Thermodynamics of Protein Separations" | \$756,209 | 2/15/01-1/31/05 |
| 34. | National Institutes of Health
(with 6 junior co-investigators)
Supplement to "COBRE: Structural and Functional Genomics" | \$500,000 | 10/1/03-9/30/04 |
| 35. | National Science Foundation
"Protein Adsorption and Transport in Chromatographic Bioprocessing" | \$260,000 | 2/15/04-1/31/08 |
| 36. | Department of Energy
(with J. Edwards, B. Ogunnaike, D. Vlachos; UD subcontract from Johns Hopkins University)
"Multiscale Modeling and Analysis of Complex Interactions in Biology" | \$378,367 | 9/1/04-8/31/08 |
| 37. | National Institutes of Health
"Preparative Chromatography of Biological Macromolecules" | \$662,440 | 3/1/05-2/28/09 |
| 38. | National Institutes of Health
(with 7 co-investigators)
"COBRE: Membrane Protein Production and Characterization" | \$10,162,640 | 6/1/05-5/31/10 |
| 39. | National Science Foundation (with M. Paulaitis,
E. Kaler and S. Sandler)
"The Thermodynamics of Protein Separations" | \$1,152,497 | 9/15/05-8/31/11 |

40.	National Science Foundation	\$305,995	9/1/08-8/31/11
	"Protein Adsorption and Transport in Chromatographic Bioprocessing"		
41.	Genentech	\$80,000	12/1/08-11/31/10
	"Formation and Characterization of Protein Gel Beads"		
42.	National Institutes of Health (with D. Colby)	\$708,656	9/17/09-9/22/11
	Supplement to "COBRE: Membrane Protein Production and Characterization"		
43.	National Science Foundation (with K. Lee)	\$300,001	5/15/10-4/30/14
	"Impurity Profiling in Chromatographic Purification of Monoclonal Antibodies"		
44.	National Institutes of Health (with 15 co-investigators)	\$5,721,426	9/10/10-5/31/16
	"COBRE: Membrane Protein Production and Characterization"		
45.	Amgen	\$29,998	11/22/10-11/21/12
	"Interactions and Phase Behavior of Monoclonal Antibodies"		
46.	Pall Corporation	\$34,642	3/1/2012-8/31/2012
	"Characterization of Protein Sorption and Transport in Q HyperCel™, S HyperCel and HyperCel STAR AX Sorbents"		
47.	National Science Foundation (with S. Fraden, D. Frenkel)	\$246,823	9/1/2012-8/31/2016
	"Materials World Network: Protein Phase Behavior - Experiments and Simulations"		
48.	EMD Millipore	\$87,736	4/1/2013-3/31/2014
	"Characterization of Chromatographic Adsorbents"		
49.	National Science Foundation (with I. Szleifer)	\$225,000	4/1/2013-3/31/2017
	"Collaborative Research: Molecular Basis for Protein Sorption in Polymer-Modified Chromatographic Media"		
50.	Genentech	\$130,000	8/7/2014-12/31/2020
	"Molecular Determinants of mAb-mAb Interactions"		
51.	Bristol-Myers Squibb	\$360,000	11/18/2015 - 11/17/2019
	"Characterization of Early Steps in Downstream Processing of Biologics"		
52.	Amgen	\$200,000	12/8/2016-1/31/2019
	"Elution Strategies For Protein Ion-Exchange Chromatography"		
53.	NIST / NIIMBL / State of Delaware	\$1,505,477	1/1/2018-6/30/2019
	"Center of Excellence in Host-Cell Protein Analysis"		
54.	Bristol-Myers Squibb	\$143,040	3/8/2019-3/7/2020

- "Yield and Impurity Clearance in Platform Chromatography Steps for Current and Next-Generation Processes"
55. NIST / NIIMBL \$920,426 (UD) 3/1/2019-8/31/2020
(with 5 collaborating institutions)
"Identification, Characterization and Removal of Host-Cell Proteins in CHO Monoclonal Antibody Biomanufacturing Processes"
 56. NIST / NIIMBL \$352,559 (UD) 5/16/2019-11/15/2020
(with 4 collaborating institutions)
"Mechanistic Modeling for Enhanced Chromatographic Productivity"
 57. NIST / NIIMBL \$550,000 (UD) 9/1/2020-8/31/2021
(A. Kloxin, PI; with C. Fromen and 2 collaborating institutions)
"Cell Separation, Processing, and Expansion for Cell Therapy Applications"
 58. National Science Foundation (W. Chen, PI) \$369,639 07/15/2021-06/30/2024
"Rapid Purification of Recombinant Proteins by Protein Nanoparticle Crosslinking and Light-Responsive Nanobodies"
 59. NIST / NIIMBL \$448,942 (UD) 2/1/2022-1/31/2025
(joint with RPI)
"Big Data Program: Downstream Modeling"
 60. NIST / NIIMBL \$434,238 4/1/2022-3/31/2023
(with W. Chen)
"Affinity Precipitation Purification of Virus-Like Particles"
 61. US FDA \$4,511,559 9/1/2022-8/31/2027
(M. Ierapetritou, PI; with E. Papoutsakis)
"Advancing Continuous Biomanufacturing of Monoclonal Antibodies Using an Experimentally Validated Modeling Platform"
 62. NIST / NIIMBL \$630,330 1/1/2023-6/30/2024
(A. Kloxin, PI; with C. Fromen and collaborating institutions)
"Innovative Scalable Technologies for Production of Cell Therapies"
 63. NIST / NIIMBL \$595,045 (UD) 6/1/2023-11/30/2025
(with 8 collaborating institutions)
"Modernizing Clearance and Quantification of Host-Cell Proteins in mAb Manufacture"
 64. Spark Therapeutics \$122,464 12/1/2023-11/30/2024
"Understanding the Microenvironment of Empty and Full AAV Capsid Using Molecular Dynamic Simulation for Application to Downstream Separation Technology"