

## Christopher L. Wirth (CLW)

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Chemical and Biomolecular Engineering	<i>(phone)</i>	216-645-3023
Macromolecular Science and Engineering (courtesy)	<i>(email)</i>	wirth@case.edu
Case School of Engineering	<i>(web)</i>	wirthlab.org
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### Highlights

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- **Graduate Degrees Awarded:** 3 PhD (Sherwin-Williams, Momentive, Dow), 5 MS Thesis
- **Research Team:** 3 PhD, 2 Postdocs
- **Publication record summary:** Thirty-three (33) published refereed journal articles, one (1) provisional patent. Twenty-three (23) published papers from independent career, one (1) in revision, one (1) submitted, and three (3) in preparation. Thirty-two (32) invited seminars.
- **Research support summary:** \$2.8M Research Funding for CLW, \$5.0M Project Total
- **National Science Foundation CAREER Award, 2018 – 2023**
- **Teaching:** Consistently high teaching evaluations across undergraduate, graduate, core, and elective courses. New teaching modalities and content developed to reach non-traditional students. Evidence for high quality teaching at two institutions. Received Nord Grant in 2022 for classroom innovation.
- **Leadership:** Chair of Programming for Area 01C Interfacial Phenomena of the American Institute of Chemical Engineers (AIChE). Cluster Lead in Sustainable Manufacturing and Materials for the CWRU Interdisciplinary Science and Engineering Building (ISEB).
- **Mentorship:** Nominee for John S. Diekhoff Award for Excellence in Graduate Mentoring and J. Bruce Jackson, MD, Award for Excellence in Undergraduate Mentoring

### Research Summary

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Our lab is focused on complex fluids, colloids, and interfacial science, all of which are materials or phenomena profoundly relevant to coatings, food, chemical products, and batteries. The approach our lab takes bridges fundamental science to applied technology, seeking to develop new knowledge facilitated through novel experiments and theoretical tools. The common thread through our projects is material systems comprised of nano- to micrometer scale ‘colloidal’ particles that are anisotropic, away from equilibrium, or in crowded environments. Beginning at CSU and now at CWRU, we continue to develop fundamental understanding for the fabrication, processing, and utilization of these materials for use in mature and next generation applications.

**Fundamentals:** Colloid and Interface Science, Complex Fluids, Active Matter, Imaging

**Applications:** Coatings, Food, Chemical Products, Batteries, Manufacturing

### Mentorship and Teaching Summary

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My primary goal as a faculty member is to effectively train engineers and scientists to pursue their career goals. My own experience in the way a Science, Technology, Engineering, and Mathematics (STEM) degree can transform the socioeconomic status of an individual has shaped this goal. This is my goal regardless of the setting, either in the classroom or in the laboratory. Further, my mentorship in both the laboratory as research advisor and classroom as teacher is guided by this goal. Innovations on this front include developing online learning modules for blended classrooms and new, chemical product focused content, meant to attract and retain non-traditional and underrepresented students.

## Appointments

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September 2024 -	<b>Visiting Research Scientist - Sabbatical</b> Dow Packaging & Specialty Plastics & Hydrocarbons The Dow Chemical Company
July 2022 -	<b>Associate Professor</b> Chemical and Biomolecular Engineering Department Macromolecular Science and Engineering Department (Courtesy) Case School of Engineering Case Western Reserve University
2020 to 2022	<b>Assistant Professor</b> Chemical and Biomolecular Engineering Department Case School of Engineering Case Western Reserve University
2014 to 2019	<b>Assistant Professor</b> Chemical and Biomedical Engineering Department Washkewicz College of Engineering Cleveland State University
2013 – 2014	<b>Postdoctoral Scholar</b> Chemical Engineering Department Soft Matter, Rheology, and Technology Laboratory KU Leuven <i>Mentors: Jan Vermant (ETH Zurich) and Michael De Volder (Cambridge)</i>
2012	<b>Research Chemist</b> Insight Group - Automotive Coatings Coatings Innovation Center PPG Industries, Inc. <i>Mentors: Kevin Gallagher (PPG) and Shelley Anna (CMU)</i>

## Education

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2012	<b>PhD in Chemical Engineering</b> Carnegie Mellon University (CMU) <i>Mentors: Dennis C. Prieve and Paul J. Sides</i>
2007	<b>BS in Chemical Engineering</b> University at Buffalo, The State University of New York

## Honors and Awards

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2024	John S. Diekhoff Award for Excellence in Graduate Mentoring ( <i>Nominee</i> )
2024	American Chemical Society Principal Investigator Development in Sustainability Award
2024	J. Bruce Jackson, MD Award for Excellence in Undergraduate Mentoring ( <i>Nominee</i> )
2022	Nord Grant Recipient
2022	John S. Diekhoff Award for Excellence in Graduate Mentoring ( <i>Nominee</i> )
2021	John S. Diekhoff Award for Excellence in Graduate Mentoring ( <i>Nominee</i> )
2018	CSU Faculty Merit Recognition Award
2018	National Science Foundation CAREER Award
2017	American Chemical Society Doctoral New Investigator Award
2012	Ken Meyer Award for Excellence in Graduate Research

- 2012 Robert R. Rothfus Graduate Fellowship
- 2011 Roy W. Weiland Graduate Fellowship
- 2011 Carnegie Institute of Technology Bertucci Graduate Fellowship
- 2009 Elected President of the Chemical Engineering Graduate Student Association
- 2007 Achievement Rewards for College Scientists (ARCS) Scholarship

### **Professional Service**

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- 2024 **Chair**, ACS Fall, “Colloid and Surface Chemistry in Energy and Sustainability”
- 2023 **Chair**, AIChE Annual Meeting “Interfacial Phenomena in Energy and Sustainability”
- 2023 **Chair for Programming**, 01C Interfacial Phenomena, AIChE Annual Meeting
- 2023 **Chair**, AIChE Annual Meeting “Connecting the Dots in Industry”
- 2023 **National Awards Programming Chair**, ACS Colloid and Surface Science Division
- 2022 **Symposium Organizer**, Janus Nanomaterials, 2023 MRS Spring Meeting
- 2022 **Chair**, AIChE Annual Meeting “Connecting the Dots in Industry”
- 2021 **Vice-Chair for Programming**, 01C Interfacial Phenomena, AIChE Annual Meeting
- 2020 **Co-Chair**, AIChE Annual Meeting (Virtual) “Electrokinetics and Interfacial Phenomena in Liquids”
- 2020 **Co-Chair**, AIChE Annual Meeting (Virtual) “Connecting the Dots in Industry”
- 2020 **Chair**, ACS National March Meeting (Virtual) “Basic Research in Colloids, Surfactants and Interfaces”
- 2019 **NSF REU Mentor**, REU: Synthesis, Assembly and Characterization of Soft Matter Systems, Cleveland State University Department of Physics
- 2019 **Chair**, AIChE Annual Meeting “Particulate and Multiphase Flows: Emulsions, Bubbles, and Droplets”
- 2019 **Chair**, AIChE Annual Meeting “Interfacial Transport Phenomena”
- 2019 **Chair**, AIChE Annual Meeting “Active Colloidal Systems”
- 2019 **Co-Chair**, AIChE Annual Meeting “Soft Matter Electrokinetics”
- 2019 **Co-Chair**, AIChE Annual Meeting “Particulate and Multiphase Flows: Colloids and Grains”
- 2018 **NSF REU Mentor**, REU: Synthesis, Assembly and Characterization of Soft Matter Systems, Cleveland State University Department of Physics
- 2018 **Chair**, AIChE Annual Meeting “Soft Matter Electrokinetics”
- 2018 **Co-Chair**, AIChE Annual Meeting “Active Colloids”
- 2018 **Co-Chair**, 92<sup>nd</sup> ACS Colloids and Surface Science Symposium, “Colloidal and Surface Forces”
- 2017 **NSF REU Mentor**, REU: Synthesis, Assembly and Characterization of Soft Matter Systems, Cleveland State University Department of Physics
- 2017 **Chair**, American Institute of Chemical Engineers Annual Meeting (AIChE) Annual Meeting “In of Honor of Dennis Prieve’s Retirement – 1 & 2”
- 2017 **Chair**, AIChE Annual Meeting “Active Colloidal Systems”
- 2017 **Co-Chair**, AIChE Annual Meeting “Emulsions and Foams”
- 2016 **Chair**, American Institute of Chemical Engineers Annual Meeting (AIChE), “Soft Matter Electrokinetics: Particles, Drops, and Bubbles”
- 2016 **Chair**, AIChE Annual Meeting “Active Colloidal Systems 1”
- 2016 **Co-Chair**, AIChE Annual Meeting “Emulsions and Foams”

- 2015 **Chair**, AIChE Annual Meeting “Soft Matter Electrokinetics: Particles, Drops, and Bubbles”
- 2015 **Panelist**, AIChE Annual Meeting Young Professionals Panel
- 2015 **Co-Chair**, 89<sup>th</sup> ACS Colloids and Surface Science Symposium Poster Session
- 2015 **Judge**, Choose Ohio First Poster Session
- 2015 - **Proposal Reviewer** for *NASA, ACS, BSF, and NSF*.
- 2014 **Judge**, AES/AIChE Annual Meeting Poster Session
- 2014 **Co-Chair**, AIChE Annual Meeting “Soft Matter Electrokinetics: Particles, Drops, and Bubbles”
- 2014 **Meeting Chair**, The Gordon Research Seminar on Colloidal, Macromolecular, and Polyelectrolyte Solutions
- 2013 **Instructor**, 14<sup>th</sup> European School on Rheology
- 2013 **Co-Chair**, AIChE Annual Meeting “Electrokinetic behavior of Micro- and Nano-Particles: Directed Assembly Under Electric Fields”
- 2013 **Judge**, AES/AIChE Annual Meeting Poster Session
- 2012 - **Reviewer** for *ACS Nano, ACS Applied Polymer Materials, Soft Matter, Physical Review E, Industrial and Engineering Chemistry Research, Langmuir, Electrophoresis, Colloids and Surfaces A, Soft Matter, Biomicrofluidics, Energy and Fuels, AIChE Journal, Journal of Colloid and Interface Science, and Materials*.
- 2012 **Chair**, AIChE Annual Meeting “Electrokinetic behavior of Micro- and Nano-Particles: Directed Assembly Under Electric Fields”

### **Publications** (\*student, #invited)

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- 38) **Watching Paint Dry: Rheology, Kinematics, and Defects in Drying Complex Fluids** MC Roffin,, MW Issa\*, H Yu\*, SV Barancyk, RM Rock, CL Wirth, and JF Gilchrist *in preparation*.
- 37) **Azimuthally Resolved Evanescent Wave Scattering from a Colloidal Ellipsoid** J Yan\*, H Yu\*, and CL Wirth, *in preparation*.
- 36) **Electrical Performance of a Formulated Carbon Black Suspension for Flow Batteries** KJ Lee\*, M Das, and CL Wirth, *in preparation*.
- 35) **An algorithm for solving the inverse problem in total internal reflection microscopy** A Doicu, DS Eremenko, CL Wirth, T Wriedt, *submitted*
- 34) **Direct measurement of surface interactions experienced by sticky microcapsules made from environmentally benign materials** H Yu\* and CL Wirth, arXiv preprint arXiv:2408.15945 (2024), *in revision*
- 33) **Impact of resin molecular weight on drying kinetics and sag of coatings** MW Issa\*, SV Barancyk, RM Rock, JF Gilchrist, and CL Wirth, *Progress in Organic Coatings* 194 (2024): 108618
- 32) **Surfactant-Driven Dynamic Changes in Rheology of Activated Carbon Slurry Electrodes** M Das, KJ Lee, and CL Wirth, *ACS Applied Materials & Interfaces* 16.32 (2024): 42049-42058
- 31) **An advanced light scattering imaging model for total internal reflection microscopy considering a stratified medium** A Doicu, DS Eremenko, CL Wirth, T Wriedt, *Journal of Quantitative Spectroscopy and Radiative Transfer* (2024), 320, 108964.

- 30) **Engineered Polypeptides as a Tool for Controlling Catalytic Active Janus Particles**<sup>#</sup> MW Issa\*, D Calderon\*, O Kamlet\*, S Asaei\*, JN Renner, and CL Wirth, *ACS Applied Engineering Materials* 1 (8), 1983-1996
- 29) **Catch like Adhesion of Red Blood Cells to Laminin in Sickle Cell Disease** U Goreke\*, S Iram\*, G Singh, S Domínguez-Medina, Y Man, A Bode, R An, JA Little, CL Wirth, M Hinczewski, and UA Gurkan, *bioRxiv preprint 2022.11.12.515898*, *Biophysical Journal* (2023)
- 28) **Surfactant Induced Catastrophic Collapse of Carbon Black Suspensions used in Flow Battery Application** KJ Lee\*, M Das, M Pitell\*, and CL Wirth, *arXiv preprint arXiv:2209.12125*, *Journal of Colloid and Interface Science*. 2023 Mar 1;633:712-22.
- 27) **Three-Dimensional Sag Tracking in Falling Liquid Films** MW Issa\*, H Yu\*, MC Roffin, SV Barancyk, RM Rock, JF Gilchrist, and CL Wirth, *Langmuir* (2022), 38, 38, 11581–11589
- 26) **Anisotropic colloidal particles near a boundary**<sup>#</sup> J Yan and CL Wirth, *Journal of Applied Physics* (2022) 131 (15), 150903.
- 25) **Elastic-Scattering Measurements of Single, Oriented, Optically Trapped Particles** JA Arnold, A Kalume, H Yu\*, CL Wirth, G Videen, and YK Pan, *Journal of Quantitative Spectroscopy and Radiative Transfer* (2022) 108223
- 24) **Scattering Morphology Resolved Total Internal Reflection Microscopy (SMR-TIRM) of Colloidal Spheres**<sup>#</sup> J Yan\*, D Efremenko, AA Vasilyeva, A Doicu, T Wriedt, and CL Wirth, *Computational Mathematics and Modeling* (2021): 1-8
- 23) **DLVO Energy Landscape of a Janus Colloid with a Non-Uniform Cap Thickness** S Rajupet\*, A Rashidi\*, and CL Wirth, *Physical Review E* (2021) 103, 032610
- 22) **Influence of PEG on the Clustering of Active Janus Colloids** M Kalil\*, NR Baumgartner\*, MW Issa\*, SD Ryan, and CL Wirth, *arXiv preprint arXiv:2101.06206* (2021), *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, 627:127191
- 21) **Developing Scattering Morphology Resolved Total Internal Reflection Microscopy (SMR-TIRM) for Orientation Detection of Colloidal Ellipsoids** A Rashidi\*, S Domínguez-Medina, J Yan\*, D Efremenko, AA Vasilyeva, A Doicu, T Wriedt, and CL Wirth, *Langmuir* (2020) 36 (43), 13041-13050
- 20) **Single and Ensemble Response of Colloidal Ellipsoids to a Nearby AC Electrode** J Yan\*, A Rashidi\*, CL Wirth, *Colloids and Surfaces A: Physicochemical and Engineering Aspects* (2020), 606:125384
- 19) **Efficient Sizing of Single Layer Graphene Oxide With Optical Microscopy Under Ambient Conditions** Q Luo\*, CL Wirth, EB Pentzer, *Carbon* (2020) 157, 395-401
- 18) **Influence of Cap Weight On the Motion Of A Janus Particle Very Near A Wall** A Rashidi\*, S Razavi, and CL Wirth, *Physical Review E* (2020) 101, 042606
- 17) **Charged Nanoparticles Quench the Propulsion of Active Janus Colloids** MW Issa\*, NR Baumgartner\*, M Kalil\*, SD Ryan, and CL Wirth, *ACS Omega* (2019) 4, (8), 13034-13041
- 16) **A Light Scattering Model for Total Internal Reflection Microscopy of Geometrically Anisotropic Particles** A Doicu, AA Vasilyeva, DS Efremenko, CL Wirth, T Wriedt, *Journal of Modern Optics* (2019): 1–13
- 15) **Purification and Assembly of DNA-Stabilized Boron Nitride Nanotubes into Aligned Films** VR Kode\*, ME Thompson\*, C McDonald\*, J Weicherding\*, T Dobrila\*, PS Fodor, CL Wirth, G Ao, *ACS Applied Nano Materials* (2019) 2, (4), 2099-2105

- 14) **Local Measurement of Janus Particle Cap Thickness** A Rashidi\*, MW Issa\*, I Martin, A Avishai, S Razavi, and CL Wirth, *ACS Applied Materials and Interfaces* (2018) 10 (37), 30925 - 30929
- 13) **Combined Effect of Surface Oxidation and Residual Alcohol on the Mechanics of a Multiwall Carbon Nanotube Laden Interface** WD Ivancic\* and CL Wirth, *Colloids and Surfaces A: Physicochemical and Engineering Aspects* (2018) 551, 42 - 49
- 12) **Motion of A Janus Particle Very Near a Wall** A Rashidi\* and CL Wirth, *Journal of Chemical Physics* (2017) 147, 224906
- 11) **Response of A Doublet to A Nearby Dc Electrode of Uniform Potential** CL Wirth and Sri Harsha Nuthalapati\*, *Physical Review E* (2016) 94, 042614

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- 10) **Langmuir Monolayer Characterization Via Polymer Microtensiometers** P Gijzenbergh, M Pepicelli, CL Wirth, J Vermant and R Puers, *Sensors & Actuators: A. Physical* (2015) 229, 110 – 117
- 9) **Fabrication of Planar Colloidal Clusters with Template-Assisted Interfacial Assembly** CL Wirth, MFL De Volder, and J Vermant, *Langmuir* (2015) 31, (5), 1632 - 1640.
- 8) **A Polymer Microdevice for Tensiometry of Insoluble Components** P Gijzenbergh, M Pepicelli, CL Wirth, J Vermant and R Puers, *Procedia Engineering* (2014) 87, 80 – 83
- 7) **Weak Electrolyte Dependence in The Repulsion of Colloids at A Water-Oil Interface** CL Wirth, EM Furst and J Vermant, *Langmuir* (2014) 30, (10), 2670 - 2675.
- 6) **Electrolyte Dependence of Particle Motion Near an Electrode During Ac Polarization** CL Wirth, PJ Sides and DC Prieve, *Physical Review E* (2013) 87, 032302
- 5) **Mechanisms for Directed Assembly of Colloidal Particles in Two Dimensions by Application of Electric Fields** PJ Sides, CL Wirth and DC Prieve. in *Electrophoretic Deposition of Nanomaterials*, 3-72. Eds. JH Dickerson and AR Boccaccini. Springer, 2012.
- 4) **Single and Pairwise Motion of Particles Near an Ideally Polarizable Electrode** CL Wirth, RM Rock, PJ Sides and DC Prieve, *Langmuir* (2011) 27, (1), 9781-9791.
- 3) **The Imaging Ammeter** CL Wirth, PJ Sides, DC Prieve, *Journal of Colloid and Interface Science* (2011) 357, (1), 1-12.
- 2) **An Imaging Ammeter for Electrochemical Measurements** PJ Sides, CL Wirth, DC Prieve, *Electrochemical and Solid-State Letters* (2010) 13, (8), F10-F12.
- 1) **2D Assembly of Colloidal Particles On a Planar Electrode<sup>#</sup>** DC Prieve, PJ Sides, CL Wirth, *Current Opinion in Colloid & Interface Science* (2010) 15, (3), 160-174.

#### **Patents (\*student)**

- 1) Q Luo\*, EB Pentzer, CL Wirth, **Process and System for Sizing Two-Dimensional Nanostructures**. US20200393364A1, United States Patent and Trademark Office, (Pending).

## Invited Seminars (\*student, <sup>s</sup>keynote)

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- 32) **Stability, Rheology, and Electrical Properties of Carbon Black Slurries for Flow Batteries**  
CL Wirth; Department of Chemical and Biomolecular Engineering, Lehigh University, November 2024
- 31) **Interactions, dynamics, and rheology of crowded colloidal suspensions**  
CL Wirth; National Renewable Energy Laboratory, November 2024
- 30) **Watching Paint Dry: Noninvasive Detection of Defects in Coatings**  
CL Wirth; Dow Performance Materials & Coatings, November 2024
- 29) **Stability, Rheology, and Electrical Properties of Carbon Black Slurries for Flow Batteries**  
CL Wirth; Department of Material Science and Engineering, West Virginia University, October 2024
- 28) **Anisotropic Colloidal Particles near a Boundary**  
CL Wirth; Department of Chemistry, September 2024
- 27) **Watching paint dry: Non-invasive detection of defects and skinning in drying complex fluids**  
CL Wirth; Ohio Soft Matter Meeting, May 2024
- 26) **Anisotropic colloidal particles near boundaries**  
CL Wirth; University of Edinburgh, IIE Seminar, June 2023
- 25) **Dynamics of multiphase fluids: Applications in sagging films and flowing suspensions**  
CL Wirth; Dow Industrial and Consumer Films, April 2023
- 24) **Anisotropic colloidal particles near boundaries**  
CL Wirth; Department of Chemical Engineering, Rochester Institute of Technology, October 2022
- 23) **Anisotropic colloidal particles near boundaries**  
CL Wirth; Department of Materials Science and Engineering, Alfred University, September 2022
- 22) **Stability of Carbon Black Slurry used in Flow Battery Applications**  
CL Wirth; Pacific Northwest National Lab, July 2022
- 21) **Image Processing Challenges and Opportunities in Specialty Chemicals**  
CL Wirth; MDS-Rely, June 2022
- 20) **Dynamics of Multiphase Fluids: Particle Interactions and Emulsion Stability**  
CL Wirth; Lubrizol, June 2022
- 19) **Watching paint dry: Kinematics and Rheology of a Drying Thin Film**  
CL Wirth; Dow Performance Materials & Coatings, June 2021
- 18) **Mapping Evanescent Wave Scattering from Colloidal Ellipsoids**  
CL Wirth; Lomonosov Readings 2020. Section: Mathematical models and methods in electromagnetics for particles simulations, characterization and synthesis, December 2020
- 17) **Influence of Nanoparticles on the Dynamics and Clustering of Active Colloids Proximate to a Boundary<sup>s</sup>**  
CL Wirth; First Global Symposium on Janus Particles, October 2020
- 16) **Probing the dynamics of colloidal particles in complex fluids and crowded environments**  
CL Wirth; Department of Macromolecular Science and Engineering, Case Western Reserve University, February 2020

- 15) **Measuring the Dynamics of Colloidal Particles with Evanescent Wave Scattering**  
CL Wirth; Louisiana Consortium for Neutron Scattering, Louisiana State University, January 2020
- 14) **Complex Colloidal Particles Near Boundaries**  
CL Wirth; Department of Physics, Wayne State University, October 2019
- 13) **Complex Colloidal Particles Near Boundaries**  
CL Wirth; Department of Chemical and Biological Engineering, Colorado School of Mines, September 2019
- 12) **Complex Colloidal Particles Near Boundaries**  
CL Wirth; Department of Chemistry, Cleveland State University, May 2019
- 11) **Brownian Dynamic Simulation and Mapping Evanescent Wave Scattering from Anisotropic Particles**  
A Rashidi\* and CL Wirth; Bremen Workshop on Light Scattering, Universität Bremen (Germany), March 2019
- 10) **Non-invasive measurement of kinematics and rheology in a drying paint**  
CL Wirth; PPG Industries, March 2019
- 9) **Influence of cap weight on the motion of a Janus particle very near a wall**  
A Rashidi\* and CL Wirth; College of Polymer Science and Polymer Engineering Seminar, University of Akron, December 2018
- 8) **Dynamics of colloidal particles in a fluid: Applications in rheology and surface force measurement**  
CL Wirth; Sherwin-Williams Company, September 2018
- 7) **The motion of a Janus particle very near a wall**  
A Rashidi\* and CL Wirth; Chemical Engineering Department, Colloids, Polymers, and Surfaces Seminar, Carnegie Mellon University, November 2017
- 6) **Microstructure of nanoparticle laden foams in porous media: Applications in unconventional oil and gas recovery**  
CL Wirth; Department of Biological, Geological and Environmental Sciences, Cleveland State University, October 2017
- 5) **Brownian dynamics of a spherical Janus particle near a boundary as a tool to investigate TIRM**  
A Rashidi\* and CL Wirth; Chemical and Biomolecular Engineering Department, Complex Fluids Engineering Seminar, University of Pennsylvania, June 2017
- 4) **Brownian dynamics of a spherical Janus particle near a boundary as a tool to investigate TIRM**  
A Rashidi\* and CL Wirth; Chemical Engineering Department, Complex Fluids Engineering Seminar, Lehigh University, June 2017
- 3) **Total Internal Reflection Microscopy of a Janus Sphere**  
A Rashidi\* and CL Wirth; Chemical and Biomolecular Engineering Department, University of Toledo, March 2017
- 2) **Total Internal Reflection Microscopy of a Janus Sphere**  
A Rashidi\* and CL Wirth; Chemical and Biomolecular Engineering Department, Ohio University, February 2017
- 1) **Directed Assembly of Isotropic and Anisotropic Colloidal Particles**  
CL Wirth; Chemical and Biomolecular Engineering Department, Case Western Reserve University, March 2015



### **Postdoctoral Scholars Trained as Research Advisor (yrs. advised, & CSU student)**

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- 58) **Dr. Prateek Dwivedi**, (2024 - present)  
Project: *Non-invasive detection of defects during coatings manufacturing*
- 57) **Dr. Sithara Vinod**, (2023 - present)  
Project: *Imaging Kinematics of Multiphase Fluid Systems*
- 56) **Dr. Mohandas**, (2021 - 2023)  
Project: *Microstructure of Carbon Black Suspensions for Flow Batteries*  
Current Position: Lab Manager, Universität Wien
- 55) **Dr. Aidin Rashidi**, (2020)  
Project: *Microstructure of nanoparticle laden foams in porous media*  
Current Position: *Research Chemist at the Sherwin-Williams Company*
- 54) **Dr. Sergio Dominguez-Medina**, (2019 – 20)  
Project: *Simulation of evanescent wave scattering from anisotropic particles*  
Current Position: *Optics Engineer at Folio Photonics*

### **Doctoral Students Trained as Research Advisor (yrs. advised, & CSU student)**

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- 53) **Muhammad Haroon**, PhD in Chemical Engineering (2023 - present)  
Thesis: *Dynamics of a Catalytically Active Janus Particle very near a Boundary*
- 52) **Kangjin Lee**, PhD in Chemical Engineering (2021 - present)  
Thesis: *Stability of Carbon Black Suspensions for Flow Batteries*
- 51) **Hairou Yu**, PhD in Chemical Engineering (2021 - present)  
Thesis: *Fabrication and Deposition of Red Blood Cell Mimicking Synthetic Capsules*
- 50) **Marola Issa**, PhD in Chemical Engineering (2020 - 2024)  
Thesis: *Kinematics and Rheology of a Drying Complex Fluid*  
Current Position: *Senior TS&D Scientist at Dow*
- 49) **Jiarui Yan**<sup>&</sup>, PhD in Chemical Engineering (2018 - 2023)  
Thesis: *Development of a Rotational Mount for SMR-TIRM*  
Current Position: *Research Chemist at Momentive*
- 48) **Aidin Rashidi**<sup>&</sup>, PhD in Chemical Engineering (2015 – 20)  
Thesis: *Kinematics and Rheology of a Drying Complex Fluid*  
Current Position: *Research Chemist at the Sherwin-Williams Company*

### **Masters Students Trained as Research Advisor (yrs. advised, & CSU student)**

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- 47) **Hairou Yu**, BUCT BS/MS in Chemical Engineering (2020 – 21)  
Project: *Kinematics and Rheology of a Drying Complex Fluid*  
Current Position: *PhD Student at CWRU*
- 46) **Mingji Li**, BUCT BS/MS in Chemical Engineering (2020 – 21)  
Project: *Measuring the Electrophoretic Mobility of a Janus Particle*
- 45) **Lilavathi M Gould**<sup>&</sup>, MS Project in Chemical Engineering (2019 – 20)  
Project: *Kinematics and Rheology of a Drying Complex Fluid*  
Current Position: *Project Engineer at Master Builder Solutions*
- 44) **Sri Harsha Nuthalapati**<sup>&</sup>, MS Project in Chemical Engineering (2015 – 18)  
Project: *Simulating the Self-Assembly of Prolate Ellipsoids at an Interface*
- 43) **Kevin Gardella**<sup>&</sup>, MS in Physics (2018 - 19)  
Project: *2D Convective Assembly of Colloidal Particles*  
Current Position: *Teacher at Midview High School*

- 42) **Mohammed Khalil**<sup>&</sup>, MS Thesis in Chemical Engineering (2019 - 20)  
Thesis: *Influence of Hydrogen Peroxide and Depletants on the Clustering of Active Janus Particles*
- 41) **Michael March**<sup>&</sup>, MS Project in Chemical Engineering (2019 – 20)  
Project: *Fabrication and Operation of a Flow-Focusing Microfluidic Device for Foam Generation*  
Current Position: *Technical Director at GuardTop, LLC*
- 40) **Nicholas Turner**<sup>&</sup>, MS Project in Chemical Engineering (2014 – 15)  
Project: *Electrophoretic Deposition of Dendritic Copper onto Carbon Graphite Heat Spreader*  
Current Position: *Project Engineer at GrafTech*
- 39) **Cornelius Obasanjo**<sup>&</sup>, MS Thesis in Chemical Engineering (2014 – 16)  
Thesis: *The Response of an Ellipsoidal Colloid Particle in an A/C Field*  
Current Position: *PhD Student at Queen’s University*
- 38) **Selwin Varghese**<sup>&</sup>, MS Thesis in Chemical Engineering (2015 - 17)  
Thesis: *Watching Paint Dry with Passive Microrheology*
- 37) **Venkateswara Rao Kode**<sup>&</sup>, MS Project in Chemical Engineering (2015 – 17)  
Project: *Production of polystyrene ellipsoidal colloidal particles via film stretching*  
Current Position: *Assistant Professor at Christian Brothers University*
- 36) **Mehul Gamara**<sup>&</sup>, MS Project in Chemical Engineering (2016 - 17)  
Project: *Fabricating Patchy Particles by Glancing Angle Deposition*  
Current Position: *Quality Engineer at DePuy Synthes Companies*
- 35) **William Ivancic**<sup>&</sup>, MS Thesis in Chemical Engineering (2015 - 17)  
Thesis: *Effect of Surface Oxidation on the Mechanics of Carbon Nanotube Laden Interfaces*  
Current Position: *Quality Engineer at NPA Coatings*
- 34) **Jiarui Yan**<sup>&</sup>, MS Thesis in Chemical Engineering (2017 - 18)  
Thesis: *Kinetics and Ensemble Dynamics of Colloidal Ellipsoids Near an A/C Electrode*  
Current Position: *PhD Student at Cleveland State University*
- 33) **William Tuttle**<sup>&</sup>, MS Project in Chemical Engineering (2016 - 17)  
Project: *Automation of ImageJ Particle Tracking Functions*  
Current Position: *Technology Manager at BASF*

**Undergraduate Students Trained as Research Advisor** (*yrs. advised, <sup>&</sup>CSU student*)

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- 32) **Snehal Choudhury**, BS in Chemical Engineering (2024 - present)
- 31) **Jintian Xue**, BEng in Chemical Engineering and Technology (Tianjin University, 2024)
- 30) **Snehal Choudhury**, BS in Chemical Engineering (2024 - present)
- 29) **Veran Stanek**, BS in Physics (Rochester Institute of Technology, 2024)
- 28) **Anders White**, BS in Chemical Engineering (2024)
- 27) **Samhita Vasudevan**, BS in Chemical Engineering (2023 - present)
- 26) **Parker Holmes**, BS in Chemical Engineering (University of Tulsa, 2022)
- 25) **Olivia Kamlet**, BS in Chemical Engineering (2022)
- 24) **Brian Cameron**, BS in Chemical Engineering (University of Akron, 2022)
- 23) **Diego Calderon**, BS in Biology (2021 - 2023)
- 22) **James Nettles**, BS in Biomedical Engineering (2021 - 2022)
- 21) **Hanjoo Oliver Lee**, BA in Chemistry and Psychology (2021 - 2022)

- 20) **John Mays**, BS in Computer Science (2021 - present)
- 19) **Matthew Pitell**, BS in Chemical Engineering (2021 - present)
- 18) **Isabel Papenbrock Romero**, BS in Chemical Engineering (2021 - 2022)
- 17) **Peter Howard**, BS in Chemical Engineering (LSU, 2019)
- 16) **Tyler Leibengood**, BS in Physics (YSU, 2019)
- 15) **Steven Bengeler**<sup>α</sup>, BS in Chemical Engineering (2019)
- 14) **Mandy Huynh**, BS in Chemical Engineering (2019)
- 13) **Sarah Buchahine**<sup>α</sup>, BS in Chemical Engineering (Honors, 2018 - 19)
- 12) **Kenneth Gregg**, BS in Physics (University of Akron, 2018)
- 11) **Naik Yusufi**<sup>α</sup>, BS in Chemical Engineering (2018)
- 10) **Marissa Trivisonno**<sup>α</sup>, BS in Chemical Engineering (2018 - 19)
- 9) **Marola Issa**<sup>α</sup>, BS in Chemical Engineering (2018 - 20)
- 8) **TJ Markiewicz**, BS in Biomedical Engineering (2017)
- 7) **Payton Lewis**<sup>α</sup>, BS in Chemical Engineering (Honors, 2017 - 18)
- 6) **Nandini Padaraju**<sup>α</sup>, BS in Chemical Engineering (2017 - 2018)
- 5) **John Juchnowski**<sup>α</sup>, BS in Chemical Engineering (2015 - 2017)
- 4) **Jason Wolf**<sup>α</sup>, BS in Mechanical Engineering (2015)
- 3) **Ian Burns**<sup>α</sup>, BS in Mechanical Engineering (2015)
- 2) **Richard Schmitt**<sup>α</sup>, BS in Chemical Engineering (2015 - 16)
- 1) **William Ivancic**<sup>α</sup>, BS in chemical engineering (2015 - 16)

**Students Supervised as Committee Member (<sup>α</sup>CSU student)**

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- 21) **Samuel Ojo**, PhD ECIV
- 20) **Sogol Asaei**, PhD ECHE
- 19) **Steven Vecchi**, PhD EMAC
- 18) **Vincent Tam**, PhD ECHE
- 17) **Lianna Johnson**, PhD ECHE
- 16) **Maura Sepesy**, PhD ECHE (graduated spring 2023)
- 15) **Jacob Hostert**, PhD ECHE (graduated spring 2023)
- 14) **Siddharth Rajupet**, MS ECHE (graduated summer 2021)
- 13) **Venkateswara Rao Kode**<sup>α</sup>, PhD ChemE (graduated spring 2021)
- 12) **Blas Quiroga**<sup>α</sup>, MS ChemE Thesis (graduated fall 2020)
- 11) **Sepehr Dejdari**<sup>α</sup>, MS ChemE Thesis (graduated summer 2020)
- 10) **Adriaan Riet**, PhD ChemE (graduated spring 2020)
- 9) **Jeremy Loss**<sup>α</sup>, MS BME Thesis (graduated spring 2019)
- 8) **Kara Ufuoma**<sup>α</sup>, MS ChemE Thesis (graduated summer 2018)
- 7) **Kevin Otto**<sup>α</sup>, MS ChemE Thesis (graduated spring 2015)
- 6) **Tara Diba**<sup>α</sup>, MS BME Thesis (CSU, graduated fall 2015)
- 5) **James Deyling**<sup>α</sup>, MS ChemE Thesis (graduated fall 2016)
- 4) **Aaron Moran**<sup>α</sup>, DRE ChemE (graduated 2018)
- 3) **Richard Schmitt**<sup>α</sup>, MS ChemE (graduated 2018)
- 2) **Supriya Upadhyay**<sup>α</sup>, MS ChemE (graduated 2018)
- 1) **Claudine Lacdao**<sup>α</sup>, MS ChemE (graduated 2017)

### Courses Taught (<sup>§</sup>new course, &<sup>&</sup>CSU course)

10)	<sup>§</sup> ECHE 370	AICHE Competition Laboratory (fall 23)
9)	ECHE 330/430	Design and Production of Fermented Beverages (summer 23)
8)	ECHE 466	Colloid Science (fall 21, spring 24)
7)	ECHE 365	Measurements Laboratory (spring 21 – 24)
6)	ENGR 225	Thermodynamics, Fluid Dynamics, Heat and Mass Transfer (fall 20, fall 22, fall 23)
5)	&ESC 720	Research Communications (fall 17, fall 18)
4)	<sup>§</sup> ,&CHE 444/544	Colloidal and Interfacial Phenomena (fall 14, fall 16, fall 18, fall 19)
3)	&CHE 506	Advanced Transport Phenomena (spring 16, spring 18, spring 19)
2)	&ESC 301	Fluid Mechanics (summer 15, spring 17, spring 18)
1)	<sup>§</sup> ,&CHE 594/694	Colloidal Hydrodynamics and Electrokinetics (fall 15)

### Outreach, Teacher Development, and Other Mentorship Activities

4) **Everyday Nano:** Umbrella program facilitated by NSF CAREER award. A multi-component Colloid and Interface Science (CIS) program in collaboration with regional partners that have so far included MC<sup>2</sup>STEM (Cleveland, OH), St. Edward's High School (Lakewood, OH), Great Lakes Science Center (GLSC), and Midview High School. Educational research has shown that focusing on applications of STEM is helpful in attracting underrepresented groups to the STEM fields. The goal of this program is to increase the number of underrepresented students interested in pursuing a career in STEM by focusing on the *everyday applications* of CIS. The program thus far as included three components, along with an outreach component:

i) *Experiential Learning:* Week-long program (2016, 2017, and 2019) seeking to have high school students learn about the broad area of Colloid and Interfacial Science and subsequently focus effort on learning about one specific product that students interact with on a daily basis.

ii) *Engineering Design:* Summer-long program (2019, 2021) with high school students participating in an engineering design project. The particular piece of hardware should facilitate testing a hypothesis or measure a specific material property of a complex fluid. A falling ball viscometer suitable for opaque fluids (*ex.* motor oil) was the project in the first iteration of the program.

iii) *Course Content Development:* Initial implementation was integrated into a 2018 Colloidal and Interfacial Science Course. The goal of the program was to have students demonstrate an ability to identify structure-property relationships in microstructured chemical products. Some examples of projects included measuring the rheology of mayonnaise, the durability of nail polish, and the sag properties of various paints.

iv) *Outreach:* Many of the concepts developed in the three course programs as part of Everyday Nano are integrated into regular outreach activities. These activities primarily take place during Engineers Week and Open Houses.

3) **Mentor for REU NSF #1659541/2244106:** *Synthesis, Assembly and Characterization of Soft Matter Systems.* Ten-week program running in the summer from 2017 – 2019 in which four (4) undergraduate researchers were mentored in lab of CLW. Home institutions of these students

included Rowan University, University of Akron, Youngstown State University, and Louisiana State University. The goal of the program was to involve sophomore and junior physics and engineering majors in meaningful interdisciplinary research projects within soft matter science and engineering.

2) **ASEE/AIChE Summer School 2017:** Attendee at the annual summer school for new Chemical Engineering faculty. Helped to develop instructional skills and long term goals, including development of a chemical product design course. The chemical product design course was central to one part of the Everyday Nano program (see *1.iii*).

1) **Faculty Online Teaching and Design Course:** Completed week-long workshop focused on online learning and course development. Workshop was administered by Cleveland State University Center for eLearning.

#### **External Research Support**

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- |     |                 |   |
|-----|-----------------|---|
| 16) | <b>Amount</b>   | \$82,991  |
|     | <b>Agency</b>   | Sherwin-Williams  |
|     | <b>Title</b>    | Phase II: Noninvasive detection of skin formation on the free surface of bulk paint |
|     | <b>Role</b>     | Lead PI   |
|     | <b>Duration</b> | September 1 <sup>st</sup> , 2024 – April 30 <sup>th</sup> , 2025                    |
| 15) | <b>Amount</b>   | \$50,000  |
|     | <b>Agency</b>   | American Chemical Society Petroleum Research Foundation                             |
|     | <b>Title</b>    | Sustainable Formulation of Packaging Materials: Films, Packaging, and Coatings      |
|     | <b>Role</b>     | Lead PI   |
|     | <b>Duration</b> | August 1 <sup>st</sup> , 2024 – May 31 <sup>st</sup> , 2025                         |
| 14) | <b>Amount</b>   | \$76,780  |
|     | <b>Agency</b>   | NSF MDS Rely IUCRC  |
|     | <b>Title</b>    | Non-invasive detection of defects during coatings manufacturing                     |
|     | <b>Role</b>     | Lead PI   |
|     | <b>Duration</b> | January 1 <sup>st</sup> , 2024 – December 31 <sup>st</sup> , 2024                   |
| 13) | <b>Amount</b>   | \$20,258  |
|     | <b>Agency</b>   | Sherwin-Williams  |
|     | <b>Title</b>    | Noninvasive detection of skin formation on the free surface of bulk paint           |
|     | <b>Role</b>     | Lead PI   |
|     | <b>Duration</b> | September 1 <sup>st</sup> , 2023 – November 30 <sup>th</sup> , 2023                 |

- 12) **Amount** \$350,000  
**Agency** National Science Foundation  
**Title** Measuring the non-uniform surface interactions experienced by a Janus particle  
**Role** Lead PI  
**Duration** September 1<sup>st</sup>, 2023 – August 31<sup>st</sup>, 2026
- 11) **Amount** \$95,778  
**Agency** Lubrizol  
**Title** Engineering Fluid Formulations to Improve Spray Cooling  
**Role** Lead PI  
**Duration** April 1<sup>st</sup>, 2023 – December 31<sup>st</sup>, 2023
- 10) **Amount** \$49,399  
**Agency** NSF MDS Rely IUCRC  
**Title** Non-invasive detection of defects during coatings manufacturing  
**Role** Lead PI  
**Duration** April 1<sup>st</sup>, 2023 – December 31<sup>st</sup>, 2023
- 9) **Amount** \$50,000  
**Agency** Lubrizol  
**Title** Determining the mechanism of demulsification for different chemical treaters  
**Role** Lead PI  
**Duration** March 1<sup>st</sup>, 2022 – November 30<sup>th</sup>, 2022
- 8) **Amount** \$2,815,000 (Wirth: \$875,226)  
**Agency** Department of Energy  
**Title** Enabling Long Duration Metal Hybrid Redox Flow Batteries  
**Role** Co - PI  
**Duration** March 1<sup>st</sup>, 2021 – March 1<sup>st</sup>, 2024
- 7) **Amount** \$537,470 (Wirth: \$233,447, + \$10,110 as NSF REU supplement)  
**Agency** National Science Foundation – Fluid Dynamics  
**Title** GOALI: Collaborative Research: Non-invasive measurement of kinematics and rheology in a drying complex fluid  
**Role** Lead PI  
**Duration** January 1<sup>st</sup>, 2020 - December 31<sup>st</sup>, 2022
- 6) **Amount** \$16,394  
**Agency** PPG Industries  
**Title** Developing the Variable Angle Inspection Microscope (VAIM) to measure kinematics of drying paint  
**Role** Lead PI  
**Duration** June 1<sup>st</sup>, 2019 – December 31<sup>st</sup>, 2019

- 5) **Amount** \$20,000 (Wirth: \$10,000)  
**Agency** Cleveland Foundation  
**Title** Internet of Things (IoT) Enabled Chemical Analysis  
**Role** Co-PI  
**Duration** January 1<sup>st</sup>, 2019 – December 31<sup>st</sup>, 2019
- 4) **Amount** \$500,000 (+ \$77,620 as NSF INTERN supplement)  
**Agency** National Science Foundation – Particulate and Multiphase Processes  
**Title** CAREER: Interrogating dense anisotropic colloidal suspensions with SMR-TIRM  
**Role** Lead PI  
**Duration** September 1<sup>st</sup>, 2018 – August 31<sup>st</sup>, 2023
- 3) **Amount** \$61,181  
**Agency** PPG Industries  
**Title** Development of a Particle Based Non-Invasive Inspection Technique for Paint – Phase II  
**Role** Lead PI  
**Duration** January 1<sup>st</sup>, 2018 – December 31<sup>st</sup>, 2018
- 2) **Amount** \$110,000  
**Agency** American Chemical Society Petroleum Research Foundation  
**Title** Microstructure and Transport of Nanoparticle Laden Foams in Porous Media  
**Role** Lead PI  
**Duration** September 1<sup>st</sup>, 2017 – August 31<sup>st</sup>, 2020 (No cost extension)
- 1) **Amount** \$59,710  
**Agency** PPG Industries  
**Title** Development of a Particle Based Non-Invasive Inspection Technique for Paint – Phase I  
**Role** Lead PI  
**Duration** January 1<sup>st</sup>, 2017 – December 31<sup>st</sup>, 2017

#### **Pending External Proposals**

- 4) **Amount** \$2,223,345  
**Agency** Department of Energy EERE  
**Title** High throughput enabled multiscale design of a slurry hybrid redox flow battery  
**Role** Lead PI  
**Duration** January 1<sup>st</sup>, 2025 – December 31<sup>st</sup>, 2027

- 3) **Amount** \$9,584,073  
**Agency** National Science Foundation  
**Title** (PRELIM) Mid-scale RI-1 (M1:IP): National Facility for Manufacturing and Characterization of Sustainable Materials (MCSM)  
**Role** Lead PI  
**Duration** September 1<sup>st</sup>, 2024 – August 31<sup>st</sup>, 2027
- 2) **Amount** \$644,525  
**Agency** National Science Foundation  
**Title** Equipment: MRI Track 1: Acquisition of a High-Speed Confocal Imaging System for Dynamic Physical and Biological Soft Systems  
**Role** Lead PI  
**Duration** September 1<sup>st</sup>, 2025 – August 31<sup>st</sup>, 2028
- 1) **Amount** \$649,126  
**Agency** National Science Foundation  
**Title** Optical control of catalytic active Janus particles with engineered peptides  
**Role** Lead PI  
**Duration** September 1<sup>st</sup>, 2024 – August 31<sup>st</sup>, 2027

#### **University Service**

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- 30) Cluster Lead, Sustainable Manufacturing and Materials, ISEB (spring 2024 - )  
29) Scribe, ECHE Tenure and Promotion Committee (fall 2023 - )  
28) CSE Representative, Faculty Development Council (fall 2023 - )  
27) Contributing Member, ECHE Diversity Committee (fall 2022 - )  
26) Chair, Graduate Recruitment Committee (fall 2022 - )  
25) Chair, Case School of Engineering Graduate Education Committee (fall 2022 - )  
24) AIChE Student Chapter Advisor (fall 2021 – fall 2023)  
23) Case School of Engineering Graduate Education Committee (fall 2020 – spring 2022)  
22) Graduate Admission and Recruitment Committee (fall 2019 – summer 2022)  
21) College of Engineering Ad-hoc Diversity Committee (CSU, spring 2019)  
20) University Space Committee (CSU, fall 2018 – spring 2019)  
19) College of Engineering Dean’s Diversity Council (CSU, fall 2018 – spring 2019)  
18) ChBME Qualifier Committee, (CSU, fall 2018 – spring 2019)  
17) Textbook Adoption Committee, (CSU, spring 2018)  
16) Search Committee, Lecturer (CSU, spring – summer 2015)  
15) Search Committee, Advancement Officer (CSU, fall 2015 – spring 2016)  
14) Search Committee, AVP for Research (CSU, spring 2016)  
13) ESC120 Curriculum Committee (CSU, spring – summer 2015)  
12) Dean’s Ad-hoc Committee (CSU, spring – summer 2015)  
11) Graduate Student Award Review Committee (CSU, spring 2016)  
10) Department Secretary (CSU, fall 2014 - spring 2016)  
9) Bell Lectureship/Seminar Series Planning Committee (CSU, fall 2016 – fall 2019)  
8) University Research Council (CSU, fall 2016 – spring 2019)  
7) Patent Review Committee (CSU, fall 2016 – spring 2019)



- 6) Retreat Planning Ad-hoc Committee (CSU, summer 2015 & 2016)
- 5) New Engineering Building Renovation Sub-Group (CSU, fall 2014)
- 4) College of Engineering Research Working Group (CSU, fall 2016)
- 3) College of Engineering Graduate Student Working Group (CSU, fall 2015 – sp. 2016)
- 2) Engineering Student Recruitment Committee (CSU, spring 2015)
- 1) Reviewer for Undergraduate Research Award (CSU, spring 2016)