Zhefei Yang

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EDUCATION

2012 – 2017 Doctor of Philosophy in Chemistry
Michigan State University
Thesis: Surfactant Effects on Polyelectrolyte Brush Swelling and Emulsion Filtration through Brush-Coated Membranes
Advisor: Professors Merlin Bruening and Volodymyr Tarabara

2008 – 2012 Bachelor of Science in Chemistry
Shandong University
Thesis: Study of the Fabrication Basing on Breath Figure Method and Properties of the Honeycomb Films of Ferrocenyl-based Oligomer and PS Composite
Advisor: Professor Jingcheng Hao

RESEARCH INTERESTS

- Synthetic polymer chemistry
- Interfacial functionalization with polymers
- Polymer self-assembly

RESEARCH EXPERIENCE

2024. 01 – Present R&D Associate – Polymer Synthesis and Characterization
Center for Nanophase Materials Sciences, Oak Ridge National Laboratory
Supervisor: Professor Rigoberto Advincula

- Discovered the swelling/hydration behavior of novel zwitterionic polymer brushes by neutron reflectometry, complemented by other techniques, such as ellipsometry, IR, QCM and SPR.
- Fabricated zwitterionic polymer brushes to study its hydration status change in response

2017. 10 – 2023. 12 Postdoctoral Researcher
Department of Polymer Science and Engineering, University of Massachusetts Amherst, Amherst, MA
Advisor: Professor Todd Emrick

- Synthesized novel polymers to fabricate mesoscale polymeric architectures via photolithography. The amphiphilicity was fine-controlled and equipped the architecture with interfacial activity. Chemical modification further enabled the architecture to capture and deliver targets.
- Realized a novel "make-and-release" process by making polymer-stabilized droplets for in situ nanoparticle growth on droplet surface and controlled release.
- Investigated the wettability and antifouling ability of polymer brushes synthesized from a novel monomer containing zwitterions and fluorinated groups, demonstrating better fouling resistance than conventional phosphocholine groups.
- Demonstrated the reactivity and deuteration of a novel zwitterion sulfothetin, by building a droplet-based delivery system with selective capturing and transportation.
- Developed a "clean-and-repair" system, utilizing polymer-coated droplets to collect particles from the pristine surface and drop off in surface defects.
- Synthesized a polymer surfactant containing reversible crosslinking units to regulate the mass transfer between droplets.

2012. 09 – 2017. 09 Graduate Research Assistant
Department of Chemistry, Michigan State University, East Lansing, MI
Advisor: Professors Merlin Bruening and Volodymyr Tarabara

- Visualized and analyzed oil coalescence on modified porous membranes with in situ microscopy observation during the dead-end and cross-flow membrane filtrations of oil/water emulsions.
- Interpreted the swelling behavior of poly(anionic) and poly(zwitterionic) brushes in the presence of anionic and cationic surfactants with in situ IR and ellipsometry. Revealed the importance of the surfactant charge during membrane filtration of emulsions.
- Fabricated poly(anionic) brush-coated nylon membranes with 100% oil rejection and negligible fouling during the filtration of sub-micron emulsions.
- Demonstrated the necessity of high charge density in membrane coating during the filtration of sub-micron emulsions, by investigating the swelling and antifouling behaviors of layer-by-layer multilayers.

2009. 07 – 2012. 05 Undergraduate Research Assistant
Department of Chemistry and Chemical Engineering, Shandong University, Jinan, China
Advisor: Professor Jingcheng Hao

- Fabricated highly ordered honeycomb membranes via the "breath figure" method and determined their electrochemical properties, followed by Ag nanoparticle deposition on these membranes as templates.
- Determined the phase transition of a mixed surfactant system by interpreting the phase behavior and rheological properties using SAXS, ^{2}H NMR, FF-TEM and rheology.

FELLOWSHIPS AND AWARDS

2017	MSU Collage of Natural Science Dissertation Completion Fellowship
2016	Partnership for International Research & Education (PIRE) Fellowship
2015-2017	MSU Graduate Student Travel Grants
2008-2010	SDU Academic Scholarship for Outstanding Undergraduate Student

PUBLICATIONS

1. Yang, Z.; Snyder, D.; Sathyan, A.; Balazs, A.; Emrick, T. Smart Droplets Stabilized by Designer Surfactants: From Biomimicry to Active Motion to Materials Healing. *Adv. Funct. Mater.* **2023,** *35*, 2306819.

2. Zhou, L.$^{+}$; Yang, Z.$^{+}$; Pagaduan, J. N.; Emrick, T. Fluorinated Zwitterionic Polymers as Dynamic Surface Coatings. *Polym. Chem.* **2023,** *14*, 32-36. ($^{+}$equally contributing authors)

3. Yang, Z.; Snyder, D.; Pagaduan, J. N.; Waldman, A.; Crosby, A. J.; Emrick, T. Mesoscale Polymer Surfactants: Photolithographic Production and Localization at Droplet Interfaces. *J. Am. Chem. Soc.* **2022,** *144*, 22059-22066.

4. Yang, Z.; Zhao, J.; Emrick, T. Functional Polymer Zwitterions as Reactive Surfactants for Nanoparticle Capture. *ACS Applied Materials & Interfaces* **2021,** *13*, 21898-21904.

5. Barber, D. M.; Yang, Z.; Prévost, L.; Du Roure, O.; Lindner, A.; Emrick, T.; Crosby, A. J. Programmed Wrapping and Assembly of Droplets with Mesoscale Polymers. *Adv. Funct. Mater.* **2020,** *30*, 2002704.

6. Tummons, E. N.; Hejase, C. A.; Yang, Z.; Chew, J. W.; Bruening, M. L.; Tarabara, V. V. Oil Droplet Behavior on Model Nanofiltration Membrane Surfaces under Conditions of Hydrodynamic Shear and Salinity. *J. Colloid Interface Sci.* **2020,** *560*, 247-259.

7. Sathyan, A.$^{+}$; Yang, Z.$^{+}$; Bai, Y.; Kim, H.; Crosby, A. J.; Emrick, T. Simultaneous "Clean-and-Repair" of Surfaces Using Smart Droplets. *Adv. Funct. Mater.* **2019,** *29*, 1805219. ($^{+}$equally contributing authors)

8. Yang, Z.$^{+}$; Zhang, S.$^{+}$; Tarabara, V. V.; Bruening, M. L. Aqueous Swelling of Zwitterionic Poly(sulfobetaine methacrylate) Brushes in the Presence of Ionic Surfactants. *Macromolecules* **2018,** *51*, 1161-1171. ($^{+}$equally contributing authors)

9. Yang, Z.; Tarabara, V. V.; Bruening, M. L. Adsorption of Anionic or Cationic Surfactants in Polyanionic Brushes and Its Effect on Brush Swelling and Fouling Resistance during Emulsion Filtration. *Langmuir* **2015,** *31*, 11790-11799.

10. Dong, R.; Xu, J.; Yang, Z.; Wei, G.; Zhao, W.; Yan, J.; Fang, Y.; Hao, J. Preparation and Functions of Hybrid Membranes with Rings of Ag NPs Anchored at the Edges of Highly Ordered Honeycomb-Patterned Pores. *Chem. Eur. J.* **2013,** *19*, 13099-13104.

11. Wang, H.; Dong, R.; Yang, Z.; Wu, J.; Jiang, S.; Song, A.; Hao, J. Phase Transition of Sodium Bis(2-ethyl-1-hexyl) Sulfosuccinate and Sodium Deoxycholate Mixtures in Aqueous Solutions. *Colloids Surf. A Physicochem. Eng. Asp.* **2013,** *436*, 846-853.

PRESENTATIONS

1. Yang, Z.; Snyder, D.; Pagaduan, J. N.; Waldman, A.; Crosby, A. J.; Emrick, T. Mesoscale Polymer Surfactants: Photolithographic Production and Localization at Droplet Interfaces (poster). UMass PSE 2022 Fall Polymer Event, Amherst, MA. 2023.
2. Yang, Z.; Sathyan, A.; Barber, D. M.; Crosby, A. J.; Emrick, T. Reactive, Functional Droplets in Bio-Inspired Materials and Smart Interfaces (poster). MIT Polymer Day 2022, Boston, MA. 2022.
3. Yang, Z.; Tarabara, V. V.; Bruening, M. L. Surfactant Effects on Polyelectrolyte Brush Swelling and Emulsion Filtration through Brush-Coated Membranes (poster). The 11th International Congress on Membranes and Membrane Processes (ICOM), San Francisco, CA. 2017.
4. Yang, Z.; Tarabara, V. V.; Bruening, M. L. Adsorption of Surfactants to Zwitterionic Polymer Brushes (oral). The Partnership for International Research & Education (PIRE) Annual Meeting, East Lansing, MI. 2016.
5. Yang, Z.; Tarabara, V. V.; Bruening, M. L. Surfactant Effects on Polyelectrolyte Brush Swelling and Emulsion Filtration through Brush-Coated Membranes (poster). The Gordon Research Conference, Membranes: Materials & Processes, New London, NH. 2016.
6. Yang, Z.; Tarabara, V. V.; Bruening, M. L. Surfactant Effect on Filtration of Oil/Water Emulsions with Polymer Brush-Modified Membranes (poster). The North American Membrane Society (NAMS) 25th Annual Meeting, Boston, MA. 2015.
7. Yang, Z.; Tarabara, V. V.; Bruening, M. L. Adsorption of Anionic or Cationic Surfactants in Polyanionic Brushes and Its Effect on Brush Swelling and Fouling Resistance during Emulsion Filtration (oral). The Partnership for International Research & Education (PIRE) Annual Meeting, Durham, NC. 2015.

MENTORING AND TEACHING EXPERIENCE

2020 – 2023 University of Massachusetts Amherst
- Trained and mentored 1 graduate student and 2 undergraduate students on experiment design, literature searching, and specific experiment skills, including monomer/polymer synthesis, photolithography, characterization techniques such as microscopy, IR spectroscopy, profilometry, etc.

2016 Spring Analytical Chemistry Laboratory, CEM 435, Michigan State University
- Trained the senior undergraduate students on analytical techniques such as AA, ICP, electrochemical workstation, and lab report writing
- Guided the students to answer real-world questions with proper design of experiment and use of techniques

2014 Fall Advanced Analytical Chemistry, CEM 434, Michigan State University
- Lectured on working principles of modern analytical techniques, such as GC, HPLC and AA for senior undergraduate students

2012 – 2015 Chemistry Laboratory I, CEM 161, Michigan State University
- Managed and trained over 300 undergraduate students on entry-level chemistry experiments, and guided them to build a connection between the experiment and the theory.

REFERENCES

Rigoberto C Advincula, Ph.D.

Group Leader, Macromolecular Nanomaterials Group, Center for Nanophase Materials Sciences

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