

Exponent®
Engineering & Scientific Consulting

Emily Chen, Ph.D.

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Professional Profile

Emily Chen, Ph.D., is a chemical engineering expert in Exponent's Thermal Science practice who applies this knowledge in fluid mechanics, transport phenomena, and microbiology to investigate product and process performance, support formulation development, and deliver technically rigorous analysis for clients in the energy, environmental, and consumer product sectors. She specializes in complex fluid flows, transport in porous media, and biophysics, bringing a combination of traditional chemical engineering and life sciences expertise to multidisciplinary problems.

Dr. Chen's consulting work encompasses product development support, formulation evaluation, and failure analysis. She develops and deploys custom microfluidic platforms, flow visualization techniques, rheological characterization, controlled lab testing protocols, and quantitative image analysis to diagnose flow behavior in complex systems and evaluate product and process performance.

Dr. Chen earned her Ph.D. in Chemical Engineering from Princeton University, where her research focused on experimentally probing viscoelastic flow instabilities in porous media using custom microfluidics together with rheology measurements and theory. Her research established links between fundamental pore-scale flow behavior and macroscopic transport phenomena, which she demonstrated could then be used to improve contaminant removal in model subsurface environments and enhance efficiency in HPLC separations.

Dr. Chen gained experience in microbiology from her postdoctoral studies in Molecular Biology at Princeton, where she investigated antibiotic resistance in bacterial biofilms colonizing medical devices by developing integrated microfluidic-RNA extraction assays. She also has experience in consumer products R&D from internships at Procter & Gamble encompassing modeling & simulation, product formulation and stability testing, and consumer product research.

Academic Credentials & Professional Honors

Ph.D., Chemical and Biological Engineering, Princeton University, 2025

M.A., Chemical and Biological Engineering, Princeton University, 2023

B.S., Chemical and Biomolecular Engineering, Cornell University, 2021

Excellence in Fluid Mechanics Research and Oral Presentation Award, American Institute of Chemical Engineers Annual Meeting, 2024

Best Poster Award, Pre-APS-DFD Satellite Meeting on Environmental and Biological Fluid Dynamics, University of Pennsylvania, 2023

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Best Poster Award, Chemical & Biological Engineering Graduate Student Symposium, Princeton University, 2023

Society of Rheology Student Travel Grant, Society of Rheology, 2022

Gordon Y. S. Wu Fellowship, Princeton University, 2021-2026

Frank & Rosa Rhodes Scholar, Cornell University, 2020-2021

Prior Experience

Postdoctoral Researcher, Department of Molecular Biology, Princeton University, 2025-2026

R&D Engineering Intern, Procter & Gamble, Cincinnati, OH, 2018, 2019, 2020

Professional Affiliations

Society of Rheology

American Physical Society: DPoly, DBio, DFD

American Institute of Chemical Engineers

Tau Beta Pi Engineering Honor Society

Publications

Chen EY, Haward SJ, Shen AQ, Datta SS. Polymer extension at stagnation points governs flow thickening of polymer solutions in ordered porous media, submitted, 2026, preprint available on arXiv: 2605.27731

Chen EY, Browne CA, Haward SJ, Shen AQ, Datta SS. Stagnation points at grain contacts generate an elastic flow instability in 3D porous media. Journal of Fluid Mechanics 2026; 1034:A4.

Chen EY, Datta SS. Elastic instability of wormlike micelle solution flow in serpentine channels. Soft Matter 2026; 21(25):5045.

Chen EY, Datta SS. Influence of fluid rheology on multistability in the unstable flow of polymer solutions through pore constriction arrays. Journal of Rheology 2025; 69(2):235.

Gritti F, Chen EY, Datta SS. Harnessing an elastic flow instability to improve the kinetic performance of chromatographic columns. Journal of Chromatography A 2024; 1735.

Presentations

Chen EY, Haward SJ, Shen AQ, Datta SS. The flow thickens: predicting macroscopic flow resistance of viscoelastic fluid flow in porous media. Oral Presentation, APS Global Physics Summit, Anaheim, CA, 2025.

Chen EY, Datta SS. Taking the easy way out: flow of wormlike micelles in confinement. Oral Presentation, Princeton Soft Materials Coffee Hour, Princeton, NJ, 2025.

Chen EY, Haward SJ, Shen AQ, Datta SS. The flow thickens: predicting macroscopic flow resistance of viscoelastic fluid flow in porous media. Oral Presentation, Princeton Center for Complex Materials IRG-B meeting, Princeton, NJ, 2024.

Chen EY, Datta SS. Leveraging viscoelastic flow instabilities for remediation of soiled porous media. Oral Presentation, APS Division of Fluid Dynamics Meeting, Salt Lake City, UT, 2024.

Chen EY, Datta SS. Leveraging viscoelastic flow instabilities for remediation of soiled porous media. Oral Presentation, American Institute of Chemical Engineers Annual Meeting, San Diego, CA, 2024.

Chen EY, Haward SJ, Shen AQ, Datta SS. The flow thickens: predicting macroscopic flow resistance of viscoelastic fluid flow in porous media. Oral Presentation, Society of Rheology Meeting, Austin, TX, 2024.

Chen EY, Datta SS. Leveraging viscoelastic flow instabilities for remediation of soiled porous media, Poster, Society of Rheology Meeting, Austin, TX, 2024.

Chen EY, Haward SJ, Shen AQ, Datta SS. The flow thickens: predicting macroscopic flow resistance of viscoelastic fluid flow in porous media. Oral Presentation, Princeton Chemical & Biological Engineering Graduate Student Symposium, Princeton, NJ, 2024.

Chen EY, Datta SS. Viscoelastic flow instabilities in porous media: insights from pore-scale flow fields. Invited Talk, Seminar at Okinawa Institute of Science and Technology, Okinawa, Japan, 2024.

Chen EY, Haward SJ, Shen AQ, Datta SS. The flow thickens: predicting macroscopic flow resistance of viscoelastic fluid flow in porous media. Oral Presentation, Future of Rheology Seminar Series, virtual, 2024.

Chen EY, Datta SS. Viscoelastic flow instabilities in porous media: insights from pore-scale flow fields. Invited Talk, BIRS Workshop on Non-Newtonian Flows in Porous Media, Melbourne, Australia, 2024.

Chen EY, Haward SJ, Shen AQ, Datta SS. The flow thickens: predicting macroscopic flow resistance of viscoelastic fluid flow in porous media. Oral Presentation, APS March Meeting, Minneapolis, MN, 2024.

Chen EY, Browne CA, Datta SS. Viscoelastic flow instabilities in ordered 3D porous media. Oral Presentation, APS Division of Fluid Dynamics Meeting, Washington D.C., 2023.

Chen EY, Datta SS. Predicting multistability of polymer solution flow in a 1-D porous medium. Oral Presentation, APS Division of Fluid Dynamics Meeting, Washington D.C., 2023.

Chen EY, Haward SJ, Shen AQ, Datta SS. The flow thickens: predicting macroscopic flow resistance of viscoelastic fluid flow in porous media. Poster, Graduate Student Symposium, Princeton, NJ, 2023.

Chen EY, Haward SJ, Shen AQ, Datta SS. The flow thickens: predicting macroscopic flow resistance of viscoelastic fluid flow in porous media. Poster, Pre-APS-DFD Satellite Meeting on Environmental and Biological Fluid Dynamics, Philadelphia, PA, 2023.

Chen EY, Browne, C. A. Datta SS. Viscoelastic flow instabilities in ordered 3D porous media. Oral Presentation, International Congress on Rheology, Athens, Greece, 2023.

Chen EY, Browne, C. A. Datta SS. Viscoelastic flow instabilities in ordered 3D porous media. Oral Presentation, APS March Meeting, Las Vegas, NV, 2023.

Chen EY, Browne, C. A. Datta SS. Viscoelastic flow instabilities in ordered 3D porous media. Oral Presentation, APS Division of Fluid Dynamics Meeting, Indianapolis, IN, 2022.

Chen EY, Browne, C. A. Datta SS. Viscoelastic flow instabilities in ordered 3D porous media. Oral Presentation, Soft Materials Coffee Hour, Princeton University, Princeton, NJ, 2022.

Chen EY, Browne, C. A. Datta SS. Viscoelastic flow instabilities in ordered 3D porous media. Oral Presentation, Society of Rheology Meeting, Chicago, IL, 2022.

Project Experience

Microfluidics and flow imaging: Quantified flow of non-Newtonian fluids in complex environments, such as packed beds, subsurface reservoirs, and soil. Microfabrication techniques including soft lithography and 3D-printing. Flow imaging using confocal, phase contrast, and birefringence microscopy. Particle image velocimetry and particle tracking.

Bacteria proliferation under dynamic mechanical environment: Performed tests to investigate bacteria proliferation in environments like body's tissues or medical devices. Expertise with bacterial culturing and imaging, RNA extraction, microbiological assay development, antibiotic efficacy studies, bacterial biofilm characterization, and biophysical modeling.

Consumer product formulation and performance: Conducted upstream formulation for shampoo and conditioner products, performing stability tests, using theoretical modeling to assess chemical stability, and performing microbiological and analytical testing for formulation optimization, failure mode analysis, and regulatory compliance. Evaluated sensory perception of shampoo formulations and conducted large-scale competitor landscape analyses.

Additional Education & Training

Assistant in Instruction, 60 students, CBE 430, Squishy Engineering: Using Soft Materials to Solve Hard Problems, Princeton University, Fall 2022

Peer Reviews

Proceedings of the National Academy of Sciences

Science Advances

Journal of Fluid Mechanics

Soft Matter

Nature Microbiology