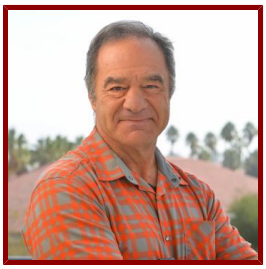
Stanford



Gerald Fuller

Fletcher Jones Professor in the School of Engineering

Chemical Engineering

NIH Biosketch available Online Curriculum Vitae available Online

CONTACT INFORMATION

- **Administrator**

  Andrea Hubbard - Administrative Associate

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Bio

BIO

The processing of complex liquids (polymers, suspensions, emulsions, biological fluids) alters their microstructure through orientation and deformation of their constitutive elements. In the case of polymeric liquids, it is of interest to obtain in situ measurements of segmental orientation and optical methods have proven to be an excellent means of acquiring this information. Research in our laboratory has resulted in a number of techniques in optical rheometry such as high-speed polarimetry (birefringence and dichroism) and various microscopy methods (fluorescence, phase contrast, and atomic force microscopy).

The microstructure of polymeric and other complex materials also cause them to have interesting physical properties and respond to different flow conditions in unusual manners. In our laboratory, we are equipped with instruments that are able to characterize these materials such as shear rheometer, capillary break up extensional rheometer, and 2D extensional rheometer. Then, the response of these materials to different flow conditions can be visualized and analyzed in detail using high speed imaging devices at up to 2,000 frames per second.

There are numerous processes encountered in nature and industry where the deformation of fluid-fluid interfaces is of central importance. Examples from nature include deformation of the red blood cell in small capillaries, cell division and structure and composition of the tear film. Industrial applications include the processing of emulsions and foams, and the atomization of droplets in ink-jet printing. In our laboratory, fundamental research is in progress to understand the orientation and deformation of monolayers at the molecular level. These experiments employ state of the art optical methods such as polarization modulated dichroism, fluorescence microscopy, and Brewster angle microscopy to obtain in situ measurements of polymer films and small molecule amphiphile monolayers subject to flow. Langmuir troughs are used as the experimental platform so that the thermodynamic state of the monolayers can be systematically controlled. For the first time, well characterized, homogeneous surface flows have been developed, and real time measurements of molecular and microdomain orientation have been obtained. These microstructural experiments are complemented by measurements of the macroscopic, mechanical properties of the films.

ACADEMIC APPOINTMENTS

- Professor, Chemical Engineering
- Member, Bio-X
- Member, Cardiovascular Institute

- Member, Maternal & Child Health Research Institute (MCHRI)
- Faculty Fellow, Sarafan ChEM-H

ADMINISTRATIVE APPOINTMENTS

- Member, Faculty Senate, (2018- present)

HONORS AND AWARDS

- Fletcher Jones Professorship II, The Fletcher Jones Foundation (2006)
- Cox Medal for Excellence in Fostering Undergraduate Research, Stanford University (2006)
- Julian C. Smith Lectureship in Chemical and Biomolecular Engineering, Cornell University
- Pearson Lecturer in Chemical Engineering, UCSB
- Bingham Medal Award, The Society of Rheology (1997)
- Fellow, American Physical Society (1993)

BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Member, Board of Managers, American Institute of Physics Publishing (2017 - present)
- Fellow, American Academy of Arts and Science (2016 - present)
- Secretary, International Committee on Rheology (2017 - present)
- Elected Member, National Academy of Engineering (2005 - present)
- President, Society of Rheology (1999 - 2001)

PROFESSIONAL EDUCATION

- PhD, Caltech (1980)

LINKS

- Fuller Reesearch Group: https://fullergroup.stanford.edu

Teaching

COURSES

2023-24

- Fluid Mechanics: CHEMENG 120A (Win)
- Graduate Practical Training: CHEMENG 299 (Aut, Sum)
- Undergraduate Practical Training: CHEMENG 199 (Sum)

2022-23

- Fluid Mechanics: CHEMENG 120A (Win)
- Graduate Practical Training: CHEMENG 299 (Aut, Win, Sum)
- Mechanics of Soft Matter: Rheology: CHEMENG 170X, CHEMENG 470 (Win)
- Special Topics in Microrheology: CHEMENG 505 (Aut)

2021-22

- Fluid Mechanics: CHEMENG 120A (Win)
- Graduate Practical Training: CHEMENG 299 (Aut, Win, Sum)
- Mechanics of Soft Matter: Rheology: CHEMENG 170X, CHEMENG 470 (Win)

- Special Topics in Microrheology: CHEMENG 505 (Aut, Win, Spr, Sum)

2020-21

- Fluid Mechanics: CHEMENG 120A (Win)
- Graduate Practical Training: CHEMENG 299 (Aut, Win, Sum)
- Multi-Component and Multi-Phase Thermodynamics: CHEMENG 110B (Win)
- Special Topics in Microrheology: CHEMENG 505 (Aut, Win, Spr, Sum)

STANFORD ADVISEES

Postdoctoral Faculty Sponsor

Suraj Borkar, Palash Dhara

Doctoral Dissertation Advisor (AC)

John Belanger, Maggie Braunreuther, Audrey Shih, Ada Undieh

Doctoral Dissertation Advisor (NonAC)

Cody Moose

Doctoral Dissertation Co-Advisor (AC)

Lucia Brunel, Diya Singhal

Postdoctoral Research Mentor

Suraj Borkar

Publications

PUBLICATIONS

- **Air-liquid intestinal cell culture allows in situ rheological characterization of intestinal mucus.** *APL bioengineering*
  Cai, P. C., Braunreuther, M., Shih, A., Spakowitz, A. J., Fuller, G. G., Heilshorn, S. C.
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- **Influence of hydrophobic particles on the film drainage during bubble-solid interaction** *PHYSICS OF FLUIDS*
  Dhara, P., Jung, B., Gala, L., Borkar, S., Fuller, G. G.
  2024; 36 (3)
- **Response of lymphatic endothelial cells to combined spatial and temporal variations in fluid flow.** *FASEB journal : official publication of the Federation of American Societies for Experimental Biology*
  Michalaki, E., Surya, V. N., Rodríguez-Hakim, M., Fuller, G. G., Dunn, A. R.
  2023; 37 (12): e23240
- **Interfacial stresses on droplet interface bilayers using two photon fluorescence lifetime imaging microscopy.** *Journal of colloid and interface science*
  Huang, Y., Chandran Suja, V., Yang, M., Malkovskiy, A. V., Tandon, A., Colom, A., Qin, J., Fuller, G. G.
  2023; 653 (Pt B): 1196-1204
- **From improving eyesight to disease theranostics: The impact of ocular fluid mechanics research** *PHYSICS OF FLUIDS*
  Suja, V., Fuller, G. G.
  2023; 35 (8)
- **The Role of Membrane-Tethered Mucins in Axial Epithelial Adhesion in Controlled Normal Stress Environments.** *Advanced biology*
  Baumli, P., Liu, C., Bek#i#, A., Fuller, G. G.
  2023: e2300043
- **Evaporation-driven gravitational instability in the liquid layer of a polymer solution: Theoretical and numerical studies** *PHYSICS OF FLUIDS*
  Hong, J., Ahn, K., Fuller, G. G., Kim, M.

2023; 35 (6)

- **Coalescence of surface bubbles: The crucial role of motion-induced dynamic adsorption layer.** *Advances in colloid and interface science*
  Zawala, J., Miguet, J., Rastogi, P., Atasi, O., Borkowski, M., Scheid, B., Fuller, G. G.
  2023; 317: 102916
- **Nondestructive rheological measurements of biomaterials with a magnetic microwire rheometer** *JOURNAL OF RHEOLOGY*
  Braunreuther, M., Liegeois, M., Fahy, J. V., Fuller, G. G.
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- **Stable High-Concentration Monoclonal Antibody Formulations Enabled by an Amphiphilic Copolymer Excipient.** *Advanced therapeutics*
  Klich, J. H., Kasse, C. M., Mann, J. L., Huang, Y., d'Aquino, A. I., Grosskopf, A. K., Baillet, J., Fuller, G. G., Appel, E. A.
  2023; 6 (1)
- **Instability and symmetry breaking of surfactant films over an air bubble** *JOURNAL OF FLUID MECHANICS*
  Shi, X., Fuller, G. G., Shaqfeh, E. G.
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- **Kitchen flows: Making science more accessible,affordable, and curiosity driven** *PHYSICS OF FLUIDS*
  Fuller, G. G., Lisicki, M., Mathijssen, A. M., Mossige, E. L., Pasquino, R., Prakash, V. N., Ramos, L.
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- **Stable High-Concentration Monoclonal Antibody Formulations Enabled by an Amphiphilic Copolymer Excipient** *ADVANCED THERAPEUTICS*
  Klich, J. H., Kasse, C. M., Mann, J. L., Huang, Y., D'Aquino, A., Grosskopf, A. K., Baillet, J., Fuller, G. G., Appel, E. A.
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- **Tear Film Stability as a Function of Tunable Mucin Concentration Attached to Supported Lipid Bilayers** *JOURNAL OF PHYSICAL CHEMISTRY B*
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  2022
- **Tear Film Stability as a Function of Tunable Mucin Concentration Attached to Supported Lipid Bilayers.** *The journal of physical chemistry. B*
  Cui, K. W., Myung, D. J., Fuller, G. G.
  2022
- **Influence of salt on the formation and separation of droplet interface bilayers** *PHYSICS OF FLUIDS*
  Huang, Y., Suja, V., Amirthalingam, L., Fuller, G. G.
  2022; 34 (6)
- **Systematic characterization of effect of flow rates and buffer compositions on double emulsion droplet volumes and stability.** *Lab on a chip*
  Calhoun, S. G., Brower, K. K., Suja, V. C., Kim, G., Wang, N., McCully, A. L., Kusumaatmaja, H., Fuller, G. G., Fordyce, P. M.
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- **A Mucin-Deficient Ocular Surface Mimetic Platform for Interrogating Drug Effects on Biolubrication, Antiadhesion Properties, and Barrier Functionality.** *ACS applied materials & interfaces*
  Madl, A. C., Liu, C., Cirera-Salinas, D., Fuller, G. G., Myung, D.
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  Biggerstaff, A., Lepech, M., Fuller, G., Loftus, D.
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- **Interfacial Assembly of Graphene Oxide: From Super Elastic Interfaces to Liquid-in-Liquid Printing** *ADVANCED MATERIALS INTERFACES*
  Kamkar, M., Erfanian, E., Bazazi, P., Ghaffarkhah, A., Sharif, F., Xie, G., Kannan, A., Arjmand, M., Hejazi, S., Russell, T. P., Fuller, G. G., Sundararaj, U.
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2021; 305

- **Flowering in bursting bubbles with viscoelastic interfaces.** *Proceedings of the National Academy of Sciences of the United States of America*
  Tammaro, D., Chandran Suja, V., Kannan, A., Gala, L. D., Di Maio, E., Fuller, G. G., Maffettone, P. L.
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- **Engineering Insulin Cold Chain Resilience to Improve Global Access.** *Biomacromolecules*
  Maikawa, C. L., Mann, J. L., Kannan, A., Meis, C. M., Grosskopf, A. K., Ou, B. S., Autzen, A. A., Fuller, G. G., Maahs, D. M., Appel, E. A.
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- **Mucin-Like Glycoproteins Modulate Interfacial Properties of a Mimetic Ocular Epithelial Surface.** *Advanced science (Weinheim, Baden-Wurttemberg, Germany)*
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- **Adsorption and Aggregation of Monoclonal Antibodies at Silicone Oil-Water Interfaces.** *Molecular pharmaceutics*
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- **Interfacial and Cohesive Properties of Corneal Epithelium**
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- **Surface energy and separation mechanics of droplet interface phospholipid bilayers.** *Journal of the Royal Society, Interface*
  Huang, Y., Chandran Suja, V., Tajuelo, J., Fuller, G. G.
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- **Understanding the adsorption and potential tear film stability properties of recombinant human lubricin and bovine submaxillary mucins in an in vitro tear film model.** *Colloids and surfaces. B, Biointerfaces*
  Rabiah, N. I., Sato, Y., Kannan, A., Kress, W., Straube, F., Fuller, G. G.
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  Rodriguez-Hakim, M., Anand, S., Tajuelo, J., Yao, Z., Kannan, A., Fuller, G. G.
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  Kamkar, M., Bazazi, P., Kannan, A., Suja, V. C., Hejazi, S. H., Fuller, G. G., Sundararaj, U.
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  Shi, X., Fuller, G. G., Shaqfeh, E. G.
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- **Mechanical and microstructural insights of Vibrio cholerae and Escherichia coli dual-species biofilm at the air-liquid interface.** *Colloids and surfaces. B, Biointerfaces*
  Abriat, C., Enriquez, K., Virgilio, N., Cegelski, L., Fuller, G. G., Daigle, F., Heuzey, M.
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- **Perpendicular alignment of lymphatic endothelial cells in response to spatial gradients in wall shear stress.** *Communications biology*
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  2020
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  Mossige, E. J., Chandran Suja, V. n., Islamov, M. n., Wheeler, S. F., Fuller, G. G.
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- **Binding partner- and force-promoted changes in alphaE-catenin conformation probed by native cysteine labeling.** *Scientific reports*
  Terekhova, K., Pokutta, S., Kee, Y. S., Li, J., Tajkhorshid, E., Fuller, G., Dunn, A. R., Weis, W. I.
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- **Mechanical Properties of Solidifying Assemblies of Nanoparticle Surfactants at the Oil-Water Interface.** *Langmuir : the ACS journal of surfaces and colloids*
  Toor, A., Forth, J., Bochner de Araujo, S., Merola, M. C., Jiang, Y., Liu, X., Chai, Y., Hou, H., Ashby, P. D., Fuller, G. G., Russell, T. P.
  2019
- **Linking aggregation and interfacial properties in monoclonal antibody-surfactant formulations** *JOURNAL OF COLLOID AND INTERFACE SCIENCE*
  Kannan, A., Shieh, I. C., Fuller, G. G.
  2019; 550: 128–38
- **Spreading of rinsing liquids across a horizontal rotating substrate** *PHYSICAL REVIEW FLUIDS*
  Walls, D. J., Ylitalo, A. S., Mui, D. L., Frostad, J. M., Fuller, G. G.
  2019; 4 (8)
- **The influence of protein deposition on contact lens tear film stability** *COLLOIDS AND SURFACES B-BIOINTERFACES*
  Rabiah, N. I., Scales, C. W., Fuller, G. G.
  2019; 180: 229–36
- **Evolution of rivulets during spreading of an impinging water jet on a rotating, precoated substrate**
  Ylitalo, A. S., Walls, D. J., Mui, D. L., Frostad, J. M., Fuller, G. G.
  AMER INST PHYSICS.2019
- **The influence of protein deposition on contact lens tear film stability.** *Colloids and surfaces. B, Biointerfaces*
  Rabiah, N. I., Scales, C. W., Fuller, G. G.
  2019; 180: 229–36
- **Linking aggregation and interfacial properties in monoclonal antibody-surfactant formulations.** *Journal of colloid and interface science*
  Kannan, A., Shieh, I. C., Fuller, G. G.

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- **Lymphatic endothelial cell calcium pulses are sensitive to spatial gradients in wall shear stress** *MOLECULAR BIOLOGY OF THE CELL*
  Surya, V. N., Michalaki, E., Fuller, G. G., Dunn, A. R.
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- **Evaporation-driven solutocapillary flow of thin liquid films over curved substrates** *PHYSICAL REVIEW FLUIDS*
  Rodriguez-Hakim, M., Barakat, J. M., Shi, X., Shaqfeh, E. G., Fuller, G. G.
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- **Lymphatic endothelial cell calcium pulses are sensitive to spatial gradients in wall shear stress.** *Molecular biology of the cell*
  Surya, V. N., Michalaki, E., Fuller, G. G., Dunn, A. R.
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  Rabiah, N. I., Romaniuk, J. A., Fuller, G. G., Scales, C. W., Cegelski, L. n.
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- **Unraveling Escherichia coli's Cloak: Identification of Phosphoethanolamine Cellulose, Its Functions, and Applications.** *Microbiology insights*
  Jeffries, J. n., Fuller, G. G., Cegelski, L. n.
  2019; 12: 1178636119865234

- **Influence of interfacial elasticity on liquid entrainment in thin foam films** *PHYSICAL REVIEW FLUIDS*
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- **Crosslink density influences the adhesive strength of silicone hydrogel surfaces against corneal epithelial cells**
  Liu, C., Scales, C. W., Fuller, G. G.
  ASSOC RESEARCH VISION OPHTHALMOLOGY INC.2018

- **Influence of tear-film component integration on contact lens wettability**
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- **Coalescence and spontaneous emulsification in the presence of asphaltenes**
  Fuller, G., Bochner, S., Merola, M., Vlassopoulos, D.
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- **Adhesion and viscoelasticity of living tissues: The live cell monolayer rheometer (LCMR)**
  Fuller, G., Pokki, J., Merola, M., Undieh, A., Hollenbeck, E., Cegelski, L.
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- **Monoclonal Antibody Interfaces: Dilatation Mechanics and Bubble Coalescence** *LANGMUIR*
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  Lee, D., Fang, C., Ravan, A. S., Fuller, G. G., Shen, A. Q.
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  Surya, V. N., Michalaki, E., Huang, E. Y., Fuller, G. G., Dunn, A. R.
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  Suja, V. C., Frostad, J. M., Fuller, G. G.
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- **Dynamic fluid-film interferometry as a predictor of bulk foam properties.** *Soft matter*
  Frostad, J. M., Tammaro, D., Santollani, L., Bochner de Araujo, S., Fuller, G. G.
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- **Interfacial Rheology of Hydrogen-Bonded Polymer Multilayers Assembled at Liquid Interfaces: Influence of Anchoring Energy and Hydrophobic Interactions** *LANGMUIR*
  Le Tirilly, S., Tregouet, C., Reyssat, M., Bone, S., Geffroy, C., Fuller, G., Pantoustier, N., Perrin, P., Monteux, C.
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- **Spreading of miscible liquids** *PHYSICAL REVIEW FLUIDS*
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  Bhamla, M. S., Balemans, C., Fuller, G. G.
  2015; 449: 428-435
- **Multiphase flow of miscible liquids: jets and drops** *EXPERIMENTS IN FLUIDS*
  Walker, T. W., Logia, A. N., Fuller, G. G.
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