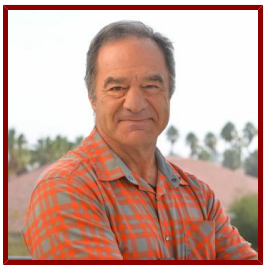
Stanford



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

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)

2019-20

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

- Mechanics of Soft Matter: Rheology: CHEMENG 470 (Win)
- Special Topics in Microrheology: CHEMENG 505 (Aut, Win, Spr, Sum)
- Undergraduate Honors Seminar: CHEMENG 191H (Aut, Win, Spr)

2018-19

- Fluid Mechanics: CHEMENG 120A (Win)
- Graduate Practical Training: CHEMENG 299 (Sum)
- Special Topics in Microrheology: CHEMENG 505 (Aut, Win, Spr, Sum)

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)

Pam Cai, Boon Siong Neo, Alp Sunol, Anni Zhang

Postdoctoral Faculty Sponsor

Philipp Baumli, Suraj Ganesh Borkar

Doctoral Dissertation Advisor (AC)

John Belanger, Maggie Braunreuther, Suzanne Calhoun, Yogi Huang, Chunzi Liu, Audrey Shih, Ada Undieh

Doctoral Dissertation Co-Advisor (AC)

Lucia Brunel, Abby Grosskopf

Postdoctoral Research Mentor

Philipp Baumli, Suraj Ganesh Borkar

Publications

PUBLICATIONS

- **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.
  2022
- **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.
  2022
- **A shape stability model for 3D printable biopolymer-bound soil composite** *CONSTRUCTION AND BUILDING MATERIALS*
  Biggerstaff, A., Lepech, M., Fuller, G., Loftus, D.
  2022; 321
- **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.
  2021
- **Determining the yield stress of a Biopolymer-bound Soil Composite for extrusion-based 3D printing applications** *CONSTRUCTION AND BUILDING MATERIALS*
  Biggerstaff, A., Fuller, G., Lepech, M., Loftus, D.
  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.
  2021; 118 (30)

- **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.
  2021
- **Mucin-Like Glycoproteins Modulate Interfacial Properties of a Mimetic Ocular Epithelial Surface.** *Advanced science (Weinheim, Baden-Wurttemberg, Germany)*
  Liu, C., Madl, A. C., Cirera-Salinas, D., Kress, W., Straube, F., Myung, D., Fuller, G. G.
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- **Instability and symmetry breaking in binary evaporating thin films over a solid spherical dome** *JOURNAL OF FLUID MECHANICS*
  Shi, X., Rodriguez-Hakim, M., Shaqfeh, E. G., Fuller, G. G.
  2021; 915
- **Adsorption and Aggregation of Monoclonal Antibodies at Silicone Oil-Water Interfaces.** *Molecular pharmaceutics*
  Kannan, A., Shieh, I. C., Negulescu, P. G., Chandran Suja, V., Fuller, G. G.
  2021
- **Dynamics of freely suspended drops translating through miscible environments** *PHYSICS OF FLUIDS*
  Mossige, E., Chandran Suja, V., Walls, D. J., Fuller, G. G.
  2021; 33 (3)
- **Interfacial and Cohesive Properties of Corneal Epithelium**
  Liu, C., Fuller, G. G.
  CELL PRESS.2021: 169A
- **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.
  2021; 18 (175): 20200860
- **Modeling and Restoring the Tear Film** *CURRENT OPHTHALMOLOGY REPORTS*
  Madl, A. C., Fuller, G. F., Myung, D.
  2020; 8 (4): 281-300
- **In-Use Interfacial Stability of Monoclonal Antibody Formulations Diluted in Saline i.v. Bags.** *Journal of pharmaceutical sciences*
  Kannan, A., Shieh, I. C., Hristov, P., Fuller, G. G.
  2020
- **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.
  2020; 195: 111257
- **Asphaltene-induced spontaneous emulsification: Effects of interfacial co-adsorption and viscoelasticity** *JOURNAL OF RHEOLOGY*
  Rodriguez-Hakim, M., Anand, S., Tajuelo, J., Yao, Z., Kannan, A., Fuller, G. G.
  2020; 64 (4): 799–816
- **Polymeric-nanofluids stabilized emulsions: Interfacial versus bulk rheology.** *Journal of colloid and interface science*
  Kamkar, M., Bazazi, P., Kannan, A., Suja, V. C., Hejazi, S. H., Fuller, G. G., Sundararaj, U.
  2020; 576: 252–63
- **Tuning corneal epithelial cell adhesive strength with varying crosslinker content in silicone hydrogel materials.** *Translational vision science & technology*
  Liu, C., Scales, C. W., Fuller, G. G.
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- **Oscillatory spontaneous dimpling in evaporating curved thin films** *JOURNAL OF FLUID MECHANICS*
  Shi, X., Fuller, G. G., Shaqfeh, E. G.
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- **Surfactant-laden bubble dynamics under porous polymer films.** *Journal of colloid and interface science*
  Kannan, A., Hristov, P., Li, J., Zawala, J., Gao, P., Fuller, G. G.

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  Czakaj, A., Kannan, A., Wisniewska, A., Grzes, G., Krzan, M., Warszynski, P., Fuller, G. G.
  2020
- **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*
  Michalaki, E. n., Surya, V. N., Fuller, G. G., Dunn, A. R.
  2020; 3 (1): 57
- **Correction: Viscoelastic interfaces comprising of cellulose nanocrystals and lauroyl ethyl arginate for enhanced foam stability.** *Soft matter*
  Czakaj, A. n., Kannan, A. n., Wi#niewska, A. n., Grze#, G. n., Krzan, M. n., Warszy#ski, P. n., Fuller, G. G.
  2020
- **Evaporation-induced Rayleigh-Taylor instabilities in polymer solutions.** *Philosophical transactions. Series A, Mathematical, physical, and engineering sciences*
  Mossige, E. J., Chandran Suja, V. n., Islamov, M. n., Wheeler, S. F., Fuller, G. G.
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  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.
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- **Linking aggregation and interfacial properties in monoclonal antibody-surfactant formulations** *JOURNAL OF COLLOID AND INTERFACE SCIENCE*
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- **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*
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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.
  2019; 30 (7): 923–31
- **Evaporation-driven solutocapillary flow of thin liquid films over curved substrates** *PHYSICAL REVIEW FLUIDS*

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  Surya, V. N., Michalaki, E., Fuller, G. G., Dunn, A. R.
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- **Carbon compositional analysis of hydrogel contact lenses by solid-state NMR spectroscopy.** *Solid state nuclear magnetic resonance*
  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*
  Lin, G., Frostad, J. M., Fuller, G. G.
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  Hollenbeck, E. C., Antonoplis, A., Chai, C., Thongsomboon, W., Fuller, G. G., Cegelski, L.
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- **Phosphoethanolamine cellulose enhances curli-mediated adhesion of uropathogenic Escherichia coli to bladder epithelial cells.** *Proceedings of the National Academy of Sciences of the United States of America*
  Hollenbeck, E. C., Antonoplis, A., Chai, C., Thongsomboon, W., Fuller, G. G., Cegelski, L.
  2018
- **The shape evolution of liquid droplets in miscible environments** *JOURNAL OF FLUID MECHANICS*
  Walls, D. J., Meiburg, E., Fuller, G. G.
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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**
  Rabiah, N. I., Scales, C. W., Fuller, G. G.
  ASSOC RESEARCH VISION OPHTHALMOLOGY INC.2018
- **Coalescence and spontaneous emulsification in the presence of asphaltenes**
  Fuller, G., Bochner, S., Merola, M., Vlassopoulos, D.
  AMER CHEMICAL SOC.2018
- **Adhesion and viscoelasticity of living tissues: The live cell monolayer rheometer (LCMR)**
  Fuller, G., Pokki, J., Merola, M., Undieh, A., Hollenbeck, E., Cegelski, L.
  AMER CHEMICAL SOC.2018
- **Monoclonal Antibody Interfaces: Dilatation Mechanics and Bubble Coalescence** *LANGMUIR*
  Kannan, A., Shieh, I. C., Leiske, D. L., Fuller, G. G.
  2018; 34 (2): 630–38
- **Droplet Coalescence and Spontaneous Emulsification in the Presence of Asphaltene Adsorption** *LANGMUIR*
  de Araujo, S., Merola, M., Vlassopoulos, D., Fuller, G. G.
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- **DACH1 stimulates shear stress-guided endothelial cell migration and coronary artery growth through the CXCL12-CXCR4 signaling axis** *GENES & DEVELOPMENT*
  Chang, A. H., Raftrey, B. C., D'Amato, G., Surya, V. N., Poduri, A., Chen, H. I., Goldstone, A. B., Woo, J., Fuller, G. G., Dunn, A. R., Red-Horse, K.
  2017; 31 (13): 1308–24

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  Bhamla, M. S., Chai, C., Alvarez-Valenzuela, M. A., Tajuelo, J., Fuller, G. G.
  2017; 12 (5)
- **Temperature controlled tensiometry using droplet microfluidics** *LAB ON A CHIP*
  Lee, D., Fang, C., Ravan, A. S., Fuller, G. G., Shen, A. Q.
  2017; 17 (4): 717-726
- **Sphingosine 1-phosphate receptor 1 regulates the directional migration of lymphatic endothelial cells in response to fluid shear stress** *JOURNAL OF THE ROYAL SOCIETY INTERFACE*
  Surya, V. N., Michalaki, E., Huang, E. Y., Fuller, G. G., Dunn, A. R.
  2016; 13 (125)
- **Impact of Compressibility on the Control of Bubble-Pressure Tensiometers** *LANGMUIR*
  Suja, V. C., Frostad, J. M., Fuller, G. G.
  2016; 32 (46): 12031-12038
- **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.
  2016: -?
- **Placing Marangoni instabilities under arrest** *PHYSICAL REVIEW FLUIDS*
  Bhamla, M. S., Fuller, G. G.
  2016; 1 (5)
- **Mechanical Behavior of a Bacillus subtilis Pellicle** *JOURNAL OF PHYSICAL CHEMISTRY B*
  Hollenbeck, E. C., Douarche, C., Allain, J., Roger, P., Regeard, C., Cegelski, L., Fuller, G. G., Raspaud, E.
  2016; 120 (26): 6080-6088
- **Multiplexed Fluid Flow Device to Study Cellular Response to Tunable Shear Stress Gradients** *ANNALS OF BIOMEDICAL ENGINEERING*
  Ostrowski, M. A., Huang, E. Y., Surya, V. N., Poplawski, C., Barakat, J. M., Lin, G. L., Fuller, G. G., Dunn, A. R.
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- **Interfacial Rheology of Hydrogen-Bonded Polymer Multilayers Assembled at Liquid Interfaces: Influence of Anchoring Energy and Hydrophobic Interactions** *LANGMUIR*
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  Walls, D. J., Haward, S. J., Shen, A. Q., Fuller, G. G.
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- **Growth Kinetics and Mechanics of Hydrate Films by Interfacial Rheology** *LANGMUIR*
  Leopercio, B. C., de Souza Mendes, P. R., Fuller, G. G.
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- **Nonmonotonic Elasticity of the Crude Oil-Brine Interface in Relation to Improved Oil Recovery** *LANGMUIR*
  Chavez-Miyauchi, T. E., Firoozabadi, A., Fuller, G. G.
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- **Instability and Breakup of Model Tear Films** *INVESTIGATIVE OPHTHALMOLOGY & VISUAL SCIENCE*
  Bhamla, M. S., Chai, C., Rabiah, N. I., Frostad, J. M., Fuller, G. G.
  2016; 57 (3): 949-958
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  Nakayama, K. H., Surya, V. N., Gole, M., Walker, T. W., Yang, W., Lai, E. S., Ostrowski, M. A., Fuller, G. G., Dunn, A. R., Huang, N. F.
  2016; 16 (1): 410-9
- **Interfacial dilatational deformation accelerates particle formation in monoclonal antibody solutions** *SOFT MATTER*
  Lin, G. L., Pathak, J. A., Kim, D. H., Carlson, M., Riguero, V., Kim, Y. J., Buff, J. S., Fuller, G. G.

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  2016; 16 (1): 410-419
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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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- **Influence of Lipid Coatings on Surface Wettability Characteristics of Silicone Hydrogels** *LANGMUIR*
  Bhamla, M. S., Nash, W. L., Elliott, S., Fuller, G. G.
  2015; 31 (13): 3820-3828
- **Interplay of Hydrogen Bonding and Hydrophobic Interactions to Control the Mechanical Properties of Polymer Multilayers at the Oil-Water Interface.** *ACS macro letters*
  Le Tirilly, S., Tregouët, C., Bône, S., Geffroy, C., Fuller, G., Pantoustier, N., Perrin, P., Monteux, C.
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- **Quantification of stromal vascular cell mechanics with a linear cell monolayer rheometer** *JOURNAL OF RHEOLOGY*
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  Hermans, E., Bhamla, M. S., Kao, P., Fuller, G. G., Vermant, J.
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  Le Tirilly, S., Tregouet, C., Bone, S., Geffroy, C., Fuller, G., Pantoustier, N., Perrin, P., Monteux, C.
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- **Molecular determinants of mechanical properties of V. cholerae biofilms at the air-liquid interface.** *Biophysical journal*
  Hollenbeck, E. C., Fong, J. C., Lim, J. Y., Yildiz, F. H., Fuller, G. G., Cegelski, L.
  2014; 107 (10): 2245-2252
- **Influence of interfacial rheology on drainage from curved surfaces.** *Soft matter*
  Bhamla, M. S., Giacomin, C. E., Balemans, C., Fuller, G. G.
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- **Using in-Situ Polymerization of Conductive Polymers to Enhance the Electrical Properties of Solution-Processed Carbon Nanotube Films and Fibers** *ACS APPLIED MATERIALS & INTERFACES*
  Allen, R., Pan, L., Fuller, G. G., Bao, Z.
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- **Scaling analysis and mathematical theory of the interfacial stress rheometer** *JOURNAL OF RHEOLOGY*
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  Ostrowski, M. A., Huang, N. F., Walker, T. W., Verwijlen, T., Poplawski, C., Khoo, A. S., Cooke, J. P., Fuller, G. G., Dunn, A. R.
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- **In-Situ Quantification of the Interfacial Rheological Response of Bacterial Biofilms to Environmental Stimuli** *PLOS ONE*
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- **Synthesis Route for the Self-Assembly of Submicrometer-Sized Colloidosomes with Tailorable Nanopores** *CHEMISTRY OF MATERIALS*
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