



Gerald Fuller

Fletcher Jones II Professor in the School of Engineering
Chemical Engineering

 NIH Biosketch available Online

 Curriculum Vitae available Online

CONTACT INFORMATION

- **Administrator**

Andrea Hubbard - Administrative Associate

Email ahubbub@stanford.edu

Tel (650) 736-1807

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).

Another application of orientation dynamics is in the development of solar cells. The efficiency of second-generation solar cells fabricated with conjugated polymers is limited by photoelectron transport within the polymer film. Inspired by electrorheological fluids, an external electric field is applied to the film to induce anisotropy in polymer crystallites, which is expected to enhance electron mobility.

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
- Faculty Fellow, Stanford ChEM-H

ADMINISTRATIVE APPOINTMENTS

- Chair, C-UAFA, (2015- 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

- 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)

Teaching

COURSES

2018-19

- Complex Fluid Interfaces: Capillarity and Interfacial Dynamics: CHEMENG 470 (Spr)
- Fluid Mechanics: CHEMENG 120A (Win)
- Special Topics in Microrheology: CHEMENG 505 (Aut, Win, Spr, Sum)

2017-18

- Fluid Mechanics: CHEMENG 120A (Win)
- Microhydrodynamics: CHEMENG 310, ME 451D (Win)
- Special Topics in Microrheology: CHEMENG 505 (Aut, Win, Spr, Sum)

2016-17

- Complex Fluid Interfaces: Capillarity and Interfacial Dynamics: CHEMENG 470 (Win)
- Fluid Mechanics: CHEMENG 120A (Win)
- Special Topics in Microrheology: CHEMENG 505 (Aut, Win, Spr, Sum)

2015-16

- Applied Mathematics in the Chemical and Biological Sciences: CHEMENG 300, CME 330 (Aut)
- Fluid Mechanics: CHEMENG 120A (Win)
- Special Topics in Microrheology: CHEMENG 505 (Aut, Win, Spr, Sum)

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)

Christopher Guido, William Murch

Postdoctoral Faculty Sponsor

Javier Tajuelo Rodriguez

Postdoctoral Research Mentor

Javier Tajuelo Rodriguez

Publications

PUBLICATIONS

- **Insertion Mechanism of a Poly(ethylene oxide)-poly(butylene oxide) Block Copolymer into a DPPC Monolayer** *LANGMUIR*
Leiske, D. L., Meckes, B., Miller, C. E., Wu, C., Walker, T. W., Lin, B., Meron, M., Ketelson, H. A., Toney, M. F., Fuller, G. G.
2011; 27 (18): 11444-11450
- **Vascular anastomosis using controlled phase transitions in poloxamer gels** *NATURE MEDICINE*
Chang, E. I., Galvez, M. G., Glotzbach, J. P., Hamou, C. D., El-Ftesi, S., Rappleye, C. T., Sommer, K., Rajadas, J., Abilez, O. J., Fuller, G. G., Longaker, M. T., Gurtner, G. C.
2011; 17 (9): 1147-U160
- **Designing a tubular matrix of oriented collagen fibrils for tissue engineering** *ACTA BIOMATERIALIA*
Lai, E. S., Anderson, C. M., Fuller, G. G.
2011; 7 (6): 2448-2456
- **Preparation of Mineralized Nanofibers: Collagen Fibrils Containing Calcium Phosphate** *NANO LETTERS*
Maas, M., Guo, P., Keeney, M., Yang, F., Hsu, T. M., Fuller, G. G., Martin, C. R., Zare, R. N.
2011; 11 (3): 1383-1388
- **Thin Film Formation of Silica Nanoparticle/Lipid Composite Films at the Fluid-Fluid Interface** *LANGMUIR*
Maas, M., Ooi, C. C., Fuller, G. G.
2010; 26 (23): 17867-17873
- **The interfacial viscoelastic properties and structures of human and animal Meibomian lipids** *EXPERIMENTAL EYE RESEARCH*
Leiske, D. L., Raju, S. R., Ketelson, H. A., Millar, T. J., Fuller, G. G.
2010; 90 (5): 598-604
- **Interfacial Flow Processing of Collagen** *LANGMUIR*
Goffin, A. J., Rajadas, J., Fuller, G. G.
2010; 26 (5): 3514-3521
- **Charge Interaction between Particle-Laden Fluid Interfaces** *LANGMUIR*
Xu, H., Kirkwood, J., Lask, M., Fuller, G.
2010; 26 (5): 3160-3164
- **Liquid Crystalline Collagen: A Self-Assembled Morphology for the Orientation of Mammalian Cells** *LANGMUIR*
Kirkwood, J. E., Fuller, G. G.
2009; 25 (5): 3200-3206
- **Langmuir Monolayers of Straight-Chain and Branched Hexadecanol and Eicosanol Mixtures** *LANGMUIR*
Kurtz, R. E., Toney, M. F., Pople, J. A., Lin, B., Meron, M., Majewski, J., Lange, A., Fuller, G. G.

2008; 24 (24): 14005-14014

- **Small Molecule, Non-Peptide p75(NTR) Ligands Inhibit A beta-Induced Neurodegeneration and Synaptic Impairment** *PLOS ONE*
Yang, T., Knowles, J. K., Lu, Q., Zhang, H., Arancio, O., Moore, L. A., Chang, T., Wang, Q., Andreasson, K., Rajadas, J., Fuller, G. G., Xie, Y., Massa, et al
2008; 3 (11)
- **Effect of Lysozyme Adsorption on the Interfacial Rheology of DPPC and Cholesteryl Myristate Films** *LANGMUIR*
Nishimura, S. Y., Magana, G. M., Ketelson, H. A., Fuller, G. G.
2008; 24 (20): 11728-11733
- **Surface rheology of hydrophobically modified PEG polymers associating with a phospholipid monolayer at the air-water interface** *LANGMUIR*
Auguste, D. T., Kirkwood, J., Kohn, J., Fuller, G. G., Prud'homme, R. K.
2008; 24 (8): 4056-4064
- **Particle bridging between oil and water interfaces** *LANGMUIR*
Xu, H., Lask, M., Kirkwood, J., Fuller, G.
2007; 23 (9): 4837-4841
- **Mechanical properties and structure of particle coated interfaces: Influence of particle size and bidisperse 2D suspensions** *LANGMUIR*
Monteux, C., Jung, E., Fuller, G. G.
2007; 23 (7): 3975-3980
- **Lipid-induced beta-amyloid peptide assemblage fragmentation** *BIOPHYSICAL JOURNAL*
Widenbrant, M. J., Rajadas, J., Sutardja, C., Fuller, G. G.
2006; 91 (11): 4071-4080
- **Effects of temperature and chemical modification on polymer Langmuir films** *JOURNAL OF PHYSICAL CHEMISTRY B*
Gavranovic, G. T., Smith, M. M., Jeong, W., Wong, A. Y., Waymouth, R. M., Fuller, G. G.
2006; 110 (44): 22285-22290
- **Interfacial rheology and structure of straight-chain and branched fatty alcohol mixtures** *LANGMUIR*
Kurtz, R. E., Lange, A., Fuller, G. G.
2006; 22 (12): 5321-5327
- **Shape and buckling transitions in solid-stabilized drops** *LANGMUIR*
Xu, H., Melle, S., Golemanov, K., Fuller, G.
2005; 21 (22): 10016-10020
- **Lung surfactant gelation induced by epithelial cells exposed to air pollution or oxidative stress** *AMERICAN JOURNAL OF RESPIRATORY CELL AND MOLECULAR BIOLOGY*
Anseth, J. W., Goffin, A. J., Fuller, G. G., Ghio, A. J., Kao, P. N., Upadhyay, D.
2005; 33 (2): 161-168
- **Pickering emulsions with controllable stability** *LANGMUIR*
Melle, S., Lask, M., Fuller, G. G.
2005; 21 (6): 2158-2162
- **Coalescence of particle-laden fluid interfaces** *LANGMUIR*
Stancik, E. J., Kouhkan, M., Fuller, G. G.
2004; 20 (1): 90-94
- **Microstructure evolution in magnetorheological suspensions governed by Mason number** *PHYSICAL REVIEW E*
Melle, S., Calderon, O. G., Rubio, M. A., Fuller, G. G.
2003; 68 (4)
- **Influence of phase transition and photoisomerization on interfacial rheology** *PHYSICAL REVIEW E*
Yim, K. S., Fuller, G. G.
2003; 67 (4)
- **Structure and dynamics of particle monolayers at a liquid-liquid interface subjected to shear flow** *General Meeting on Non-Equilibrium Behaviour of Colloidal Dispersions*

Stancik, E. J., Gavranovic, G. T., Widenbrant, M. J., Laschitsch, A. T., Vermant, J., Fuller, G. G.
ROYAL SOC CHEMISTRY.2003: 145–156

- **Polarizable particle aggregation under rotating magnetic fields using scattering dichroism** *JOURNAL OF COLLOID AND INTERFACE SCIENCE*
Melle, S., Calderon, O. G., Fuller, G. G., Rubio, M. A.
2002; 247 (1): 200-209
- **Structure and dynamics of magnetorheological fluids in rotating magnetic fields** *Physical review. E, Statistical physics, plasmas, fluids, and related interdisciplinary topics*
Melle, S., Fuller, G. G., Rubio, M. A.
2000; 61 (4 Pt B): 4111–17