Professional Vita
Michael Loewenberg

Department of Chemical Engineering
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Research Interests: Dynamics of Complex Fluids

Rheology of emulsions and foams	Microfluidics
Interfacial flows, surfactant effects	Microcirculation, membranes
Drop breakup and coalescence	Transport in microstructured media

Education

Ph.D. Chemical Engineering

California Institute of Technology, June 1988
Dissertation Advisor: Professor G.R. Gavalas
"Heterogeneous reaction and diffusion in microstructured materials"

B.S. Chemical Engineering

Purdue University, May 1982

Academic Positions

Professor, Department of Chemical Engineering
Yale University, 2003-present

Associate Professor, Department of Chemical Engineering
Yale University, 2000-2003

Assistant Professor, Department of Chemical Engineering
Yale University, 1995-2000

Awards

- Presidential Early Career Award for Scientists and Engineers (PECASE) for "novel research on viscous multiphase fluids leading to the development of predictive models for use in the chemical and manufacturing industries," 1999.
- Outstanding Paper Award "Drop deformation and breakup in isotropic turbulence." AIChE annual meeting, 1997
- CAREER Award, National Science Foundation, 1996
- Graduate Mentor Award, Yale University, 2003
- Junior Faculty Fellowship, Yale University, 1999
- Arthur Greer Memorial Prize, Yale University, 1997

Awards to Students for Dissertation Research

- American Physical Society, Andreas Acrivos Dissertation Prize in Fluid Dynamics awarded to Vittorio Cristini "for important theoretical and numerical contributions to the description and understanding of drop dynamics and breakup in laminar and turbulent flows," 2000.
- Henry Prentiss Becton Prize, Yale University, awarded to Vittorio Cristini for "exceptional achievements in the field of engineering and applied science," 2000.

Publications

1. Loewenberg, M., Bellan, J. & Gavalas, G.R. 1987 A simplified description of char combustion. *Chem. Eng. Commun.* **58**, 89-103.
2. Loewenberg, M. & Gavalas, G.R. 1988 Steady-state reactant flux into a medium containing spherical sinks. *Chem. Eng. Sci.* **43**, 2431-2444.
3. Levendis, Y.A., Nam, S., Loewenberg, M., Flagan, R.C. & Gavalas, G.R. 1989 The effects of the catalytic activity of calcium in the combustion of carbonaceous particles. *Energy Fuels* **3**, 28-37.
4. Loewenberg, M. & Gavalas, G.R. 1989 Time-dependent, diffusion-controlled reactions: the influence of boundaries. *J. Chem. Phys.* **90**, 177-182.
5. Loewenberg, M. 1989 Reactant flux into a medium containing spherical sinks: the time dependent problem. *Chem. Eng. Sci.* **44**, 2394-2398.
6. Loewenberg, M. & Levendis, Y.A. 1991 Combustion behavior and kinetics of synthetic and coal-derived chars: comparison of theory and experiment. *Combust. Flame.* **84**, 47-65.
7. Loewenberg, M. & O'Brien, R. W. 1992 The dynamic mobility of nonspherical particles. *J. Colloid Interface Sci.* **150**, 158-168.
8. Loewenberg, M.&Davis, R.H. 1993 Near-contact thermocapillary migration of a nonconducting viscous drop normal to a planar interface. *J. Colloid Interface Sci.* **160**, 265-274.
9. Loewenberg, M. 1993 The unsteady Stokes resistance of arbitrarily oriented, finite-length cylinders. *Phys. Fluids A* **5**, 3004-3006.
10. Loewenberg, M. & Davis, R.H. 1993 Near-contact, thermocapillary motion of two nonconducting drops. *J. Fluid Mech.* **256**, 107-131.
11. Loewenberg, M. 1993 Stokes resistance, added mass, & Basset force for arbitrarily oriented, finite-length cylinders. *Phys. Fluids* A. **5**, 765-767.
12. Loewenberg, M. 1994 Unsteady, electrophoretic motion of a nonspherical, colloidal particle in an oscillating electric field. *J. Fluid Mech.*, **278**, 149-174.
13. Loewenberg, M. & Davis, R.H. 1994 Flotation efficiencies of fine, spherical particles and drops. *Chem. Eng. Sci.*, **49**, 3923-3941.

14. Loewenberg, M. 1994 Asymmetric, unsteady Stokes flow past an oscillating, finite-length cylinder; the macroscopic effect of particle edges. *Phys. Fluids* **6**, 1095-1107.

15. Loewenberg, M. 1994 Diffusion-controlled, heterogeneous reaction in a material with a bimodal pore-size distribution. *J. Chem. Phys.* **100**, 7580-7589.

16. Loewenberg, M. 1994 Axisymmetric, unsteady Stokes flow past an oscillating, finite-length cylinder. *J. Fluid Mech.* **265**, 265-288.

17. Loewenberg, M. & Davis, R.H. 1995 Near-contact, electrophoretic particle motion. *J. Fluid Mech.*, **288**, 103-122.

18. Nichols, C.S., Loewenberg, M. & Davis, R.H. 1995 Electrophoretic particle aggregation. *J. Colloid Interface Sci.*, **176**, 342-351.

19. Loewenberg, M. & Hinch, E.J. 1996 Numerical simulation of a concentrated emulsion in shear flow. *J. Fluid Mech.* **321**, 395-419.

20. Wang, H., Zheng, S., Loewenberg, M. & Davis, R.H. 1997 Particle aggregation due to combined gravitational and electrophoretic motion. *J. Colloid Interface Sci.* **187**, 213-220.

21. Loewenberg, M. & Hinch, E.J. 1997 Collision of deformable drops in shear-flow. *J. Fluid Mech.* **338** 299-315.

22. Loewenberg, M. 1998 Numerical simulation of concentrated emulsion flows. *J. Fluids Eng.* **120**, 824-832.

23. Manga, M., Castro, J., Cashman, K.V. & Loewenberg, M. 1998 Rheology of bubble-bearing magmas: theoretical results. *J. Volcanology & Geothermal Res.* **87**, 15-28.

24. Cristini, V., Bławzdziewicz, J. & Loewenberg, M. 1998 Drop breakup in three-dimensional viscous flows. *Phys. Fluids Letters* **10**, 1781-1783.

25. Cristini, V., Bławzdziewicz, J. & Loewenberg, M. 1998 Near-contact motion of spherical surfactant-covered droplets. *J. Fluid Mech.* **366**, 259-287.

26. Ramirez, J., Zinchenko, A., Loewenberg, M. & Davis, R.H. 1999 The flotation rates of fine spherical particles under Brownian and convective motion. *Chem. Eng. Sci* **54**, 149-157.

27. Bławzdziewicz, J., Wajnryb, E. & Loewenberg, M. 1999 Hydrodynamic interactions and collision efficiencies of surfactant-covered spherical drops: incompressible surfactant films. *J. Fluid Mech.* **395**, 29-59.

28. Bławzdziewicz, J., Cristini, V. & Loewenberg, M. 1999 Near-contact motion of spherical surfactant-covered droplets: ionic surfactants. *J. Colloid Interface Sci.* **211**, 355-366.

29. Kraynik, A.M., Reinelt, D.A. & Loewenberg, M. 1999 Foam Microrheology. In *Foams and Films* D. Weaire and J. Banhart (eds.), Verlag MIT.

30. Bławzdziewicz, J., Cristini, V. & Loewenberg, M. 1999 Stokes flow in the presence of a planar interface covered with incompressible surfactant. *Phys. Fluids* **11**, 251-258.

31. Bławzdziewicz, J., Vlahovska, P., & Loewenberg, M. 2000 Rheology of a dilute dispersion of surfactant-covered spherical drops. *Physica A* **276**, 50-85.

32. Nemer, M., Bławzdziewicz, J. & Loewenberg, M. 2001 Linear viscoelasticity of concentrated emulsions. In *Mechanics for a new millennium*, 75-84, H. Aref and J.W. Phillips (eds.), Kluwer.

33. Cristini, V., Bławzdziewicz, J. & Loewenberg, M. 2001 An adaptive mesh algorithm for evolving surfaces: simulations of drop breakup and coalescence. *J. Comp. Phys.* **168** 445-463.

34. Manga, M. & M. Loewenberg, 2002 Viscosity of magmas containing highly deformable bubbles. *J. Volcanology & Geothermal Res.* **105** 19-24.

35. Vlahovska, P., Blawzdziewicz, J. & Loewenberg, M., 2002, Nonlinear rheology of a dilute emulsion of surfactant-covered spherical drops in time-dependent flows. *J. Fluid Mech.* **463**, 1–24.

36. Blawzdziewicz, J, Cristini, V. & Loewenberg, M. 2002, Critical behavior of drops in linear flows: I. phenomenological theory for drop dynamics near critical stationary states. *Phys. Fluids* **14** 2709–2718.

37. Bławzdziewicz, J., Cristini, V. & Loewenberg, M., 2003, Multiple stationary drop shapes in strain-dominated linear Stokes flows. *Phys. Fluids Letters* **15**, L37-40.

38. Patel, P.D., Shaqfeh, E.S.G., Butler, J.E., Cristini, V.,Bławzdziewicz J. & Loewenberg, M. 2003 Drop breakup in the flow through fixed fiber beds: An experimental and computational investigation. *Phys. Fluids* **15**, 1146-1157.

39. Cristini, V., Bławzdziewicz, J., Loewenberg, M. & Collins, L.R. 2003 Breakup in stochastic Stokes flows: sub-Kolmogorov drops in isotropic turbulence. *J. Fluid Mech.* **492**, 231–250.

40. Cristini, V., Guido, S., Alfani, A., Bławzdziewicz, J. & Loewenberg, M. 2003 Drop breakup and fragement size distribution in shear flow. *J. Rheol.* **47**, 1283–1298.

41. Cunha, F.R. & Loewenberg M. 2003 A study of emulsion expansion by a boundary integral method. *Mech. Res. Commun.* **30**, 639–649.

42. Nemer, M., Chen, X., Papadopoulos, D. H., Bławzdziewicz, J.& Loewenberg, M., 2004, Hindered and accelerated coalescence of drops in Stokes flow. *Phys. Rev. Letters* **92**, 114501.

43. Ismail A.E. & Loewenberg, M. 2004 Long-time evolution of a drop size distribution by coalescence in a linear flow. *Phys. Rev. E.* **69** 46307.

44. Vlahovska, P., Blawzdziewicz, J. & Loewenberg, M., 2005, Deformation of a surfactant-covered drop in a linear flow. *Phys. Fluids*, bf 17, 103103.

45. Nemer, M.B., Chen, X., Papadopoulos, D.H., Blawzdziewicz, J, & Loewenberg, M., 2007, Comment on "Two touching spherical drops in uniaxial extensional flow: Analytical solution to the creeping flow problem". *J. Colloid Interface Sci.*, **308**, 1–3.

46. Hashmi, S.M., Loewenberg, M. & Dufresne, E.R., 2007, Spatially extended FCS for visualizing and quantifying high-speed multiphase flows in microchannels. *Optics Express*, **15** 6528-6533.

47. Vlahovska, P.M., Bławzdziewicz, J. & Loewenberg, M., 2009, Small deformation theory for a surfactant-covered drop in linear flows. *J. Fluid Mech.*, **624** 293-337.

48. Santoro, P. & Loewenberg, M., 2009, Coalescence of drops with tangentially mobile interfaces: effects of ambient flow. *Ann. N.Y. Acad. Sci.* **1161**, 277–291.

49. Janssen, P.J.A., Anderson, P.D. & Loewenberg, M., 2010, A slender-body theory for low-viscosity drops in shear-flow between parallel walls. *Phys. Fluids*, **22** 042002.

50. Ramachandran, A., Loewenberg, M. & Leighton, D.T., 2010, A constitutive equation for droplet distribution in unidirectional flows of dilute emulsions for low capillary numbers. *Phys. Fluids*, **22** 083301.