VIVEK SHARMA

Hatsopoulos Microfluids Laboratory, Massachusetts Institute of Technology
77 Massachusetts Ave, Bldg 3-249g, MIT, Cambridge, MA, 02139.
Website: http://web.mit.edu/viveks/www/ Email: viveks@mit.edu

RESEARCH & TEACHING INTERESTS

Soft matter, Interfaces and Complex Fluids: Optics, Dynamics, Elasticity & Self-Assembly (ODES)

Experimental and theoretical aspects of shear, extensional and interfacial rheology, capillarity and wetting, jettability, spinnability, sprayability, self-assembly & optics of polymers, liquid crystals, colloids, proteins, biomaterials;

Droplet physics: breath figures, dew, clouds, fog, surface tension-driven flows.

Chemical & materials engineering – mass transfer, fluid mechanics, thermodynamics;

Inspiration or questions from nature & industry, especially energy applications & biophysics.

EDUCATION

Massachusetts Institute of Technology, Cambridge, MA
Post-doctoral Research Associate in Mechanical Engineering, Sept 2008-date.

Georgia Institute of Technology, Atlanta, GA
Ph.D. in Polymer Science & Engineering, September 2008. Minor in Physics.
MS in Chemical Engineering. December 2006. Minor in Nonlinear Dynamics & Chaos.

University of Akron, OH
MS in Polymer Science, May 2003.

Indian Institute of Technology, Delhi, India
B. Tech. in Textile Technology. May 2001. Focus on Polymers & Fibers.

RESEARCH EXPERIENCE

Massachusetts Institute of Technology, Cambridge, MA
Post-doctoral Research Associate, Hatsopoulos Microfluids Laboratory (HML). Sept 2008-
Research Advisor: Prof. Gareth H. McKinley, Department of Mechanical Engineering.

Jettability and sprayability of associative polymer solutions and particle-laden fluids. Interfacial viscosity and viscoelasticity of globular proteins and biofluids.

1366 Technologies Inc, Lexington, MA
Chemical Engineering Consultant. Apr 2011-
Supervisor: Prof. Emanuel M. Sachs, Chief Technical Officer, 1366 Technologies Inc. & Professor, Department of Mechanical Engineering, MIT, Cambridge, MA.

Theoretical and experimental projects involving complex fluids to assist in manufacturing innovations for creating efficient ways of harnessing solar energy.

Georgia Institute of Technology, Atlanta, GA
Research Assistant, Center for Advanced Research in Optical Microscopy. May 2006-Aug 2008
Advisor: Prof. Mohan Srinivasarao, School of Material Science and Enginering (MSE).

Doctoral Thesis: "Colloidal gold nanorods, iridescent beetles and breath figure-templated assembly of ordered arrays of pores in polymer films"

Research Assistant, Center for Nonlinear Science, Jan 2004- Dec 2005
Advisors: Prof. Michael Schatz & Prof. Roman Grigoriev, Center for Nonlinear Science & School of Physics.

Opto-microfluidics: Developed a unique technique for fast micro-fluidic chaotic mixing & control of flow using thermo-optic actuation.

University of Akron, Akron, OH
Research Assistant, FTIR Imaging and Polymer Rheology, Aug 2001- May 2003
Research Advisor: Prof. Shi-Qing Wang, Department of Polymer Science.

MS Thesis: "Rheological study of anomalous modification of Aroclor dynamics by dissolved 1,2-polybutadiene and the resulting negative intrinsic viscosity"

Indian Institute of Technology, Delhi, India
Research Intern, Fiber Science and Production Laboratory. Aug 2000- June 2001
Research Advisor: (Late) Prof. Pushpa Bajaj, Department of Textile Technology.

B. Tech. Thesis: "Preparation and properties of carbon fibers using PAN-based precursors"
Determined degradation kinetics of the epoxy paints for K. V. Microwave Industries. (May '01)
Evaluated how structure-properties of polyethylene terepthalate (PET) filaments change in high speed spinning for Reliance Industries. (Fall 2000)

Reliance Industries
Intern, Indian Polyfibers Ltd., Barabanki, (U.P.). Summer 2000

SCIENTIFIC PUBLICATIONS

Journal Publications

V. Sharma, A. Jaishankar, Y. Wang and G. H. McKinley, "Apparent yield stress, interfacial viscosity and high shear rate viscosity of Bovine Serum Albumin Solutions," *Soft Matter,* **DOI**:10.1039/C0SM01312A.

V. Sharma, L. Song, R. L. Jones, P. R. Williams and M. Srinivasarao ""Effect of solvent choice on breath-figure-templated assembly of 'holey' polymer films", *EPL*, 91, 38001 (2010) .

V. Sharma, M. Crne, J. O. Park and M. Srinivasarao "Structural Origin of Circularly Polarized Iridescence in Jeweled Beetles," *Science*, 325, 449 (2009).

Featured on **NSF Website**, 'audio-visual slides'
http://www.nsf.gov/news/newsmedia/beetles/
Research highlighted in Chemical & Engineering News and Technology Review, BBC News, Photonics.com, US News, NBC News, Yahoo News, Georgia Tech News, Mumbai Mirror, Azonano.com, Thaindian.com, etc.
Research highlighted in

Perspective "Evolutionary Photonics with a Twist" *Science*, 325, 98 (2009).

Back Scatter "The Chirality of Beetles", *Physics Today*, 84, Sept 2009

Cell Culture "Carving Corners", *Cell*, 141, 3, 916 (2010).

V. Sharma, K. Park and M. Srinivasarao "Colloidal dispersion of gold nanorods: Historical background, optical properties, synthesis, separation and self-assembly," *Material Science and Engineering Reports,* 65, 1 (2009).

V. Sharma, K. Park and M. Srinivasarao **"**Shape Separation of gold nanorods using centrifugation," *Proceedings of National Academy of Sciences,* 106(13), 4981 (2009).

Press: Featured as research highlight in *Analytical Chemistry*, April 09, 2009.

R.O. Grigoriev, M.F. Schatz and **V. Sharma** "Chaotic mixing in microdroplets," *Lab on a chip*, 6, 1369 (2006).

A. M. Ardekani, **V. Sharma** and G. H. McKinley, "Dynamics of bead formation, filament thinning and breakup in weakly viscoelastic jets", *J. Fluid Mech.*, 665, 46, (2010): DOI: 10.1017/S0022112010004738

L. Song, **V. Sharma**, J. O. Park and M. Srinivasarao, "Characterization of ordered arrays of micropores in a polymer film," *Soft Matter,* 7, 1890 (2011): DOI: 10.1039/C0SM00664E

M. Crne, **V. Sharma,** J. Blair, J. O. Park, C. J. Summers and M. Srinivasarao **"**Mimicry of *Papilio Palinurus* Butterfly Optical Effects", *EPL,* 93 (1), (2011) DOI: 10.1209/0295-5075/93/14001

S.J. Haward, **V. Sharma** and J. A. Odell, "An Cross-slot Oscillatory Flow Extensional rheometer (COFER) for Low Volumes and Ultra-dilute Complex Fluids," (*accepted in Soft Matter*).

A. Jaishankar, **V. Sharma** and G. H. McKinley, "Apparent bulk yield stress, interfacial creep ringing and interfacial viscoelasticity of globular protein/surfactant mixtures," (*accepted for Special issue in Soft Matter on interfacial rheology).*

V. Sharma and M. Srinivasarao "Growth of ordered arrays of non-coalescing and monodisperse water drops over evaporating polymer solutions," *(in preparation).*

V. Sharma, A. M. Ardekani, J. G. Serdy, P. Threfall-Holmes and G. H. McKinley, "The life and death of a viscoelastic jet: Fluid mechanics and rheometry," (*in preparation*).

V. Sharma, O. Pessinet, J. G. Serdy, A. Suderland, P. Threfall-Holmes and G. H. McKinley, "Tethered cellulose ethers: shear and extensional rheology of ethyl-hydroxyethyl cellulose (EHEC) and hydrophobically modified analogue, HMEHEC," (*in preparation*).

V. Sharma and M. Srinivasarao "Non-coalescent water drops," *(in preparation).*

Book Chapters

M. Srinivasarao, M. Crne, V. Sharma and J. O. Park, "Scarab Beetle Iridescence", *McGraw-Hill 2011 Yearbook of Science and Technology*.
M. Srinivasarao, V. Sharma, J. O. Park, M. S. Barrow and P. R. Williams, "Fabrication of nano/ microstructured organic polymer films using condensation: Self-assembly of breath figures", in *Evaporative self-assembly of ordered complex structures*, *World Scientific Publishing Company* (Singapore) (*in press; 2011*).

Proceedings

K.C. Park, V. Sharma, R.E. Cohen and G.H. McKinley, "Drop impact dynamics of complex fluids on dry, nanotextured surfaces", *18th Ostwalkd Koll.*, May 2011, Mainz, Germany

V. Sharma, A. Jaishankar and G. H. McKinley "Rheology of globular proteins: Apparent yield stress and interfacial viscoselasticity of bovine serum albumin solutions", *Polymer Preprints*, ACS Fall Meeting, Denver, 2011.

V. Sharma, A. M. Aredkani and G. H. McKinley, "'Beads on a string' structures and extensional rheometry using jet break-up", *5th Pacific Rim Conference on Rheology*, Japan, August 2010.

A. M. Ardekani, V. Sharma and G. H. McKinley, "Jetting and breakup of weakly viscoelastic liquids", *16th US National Congress of Theoretical & Applied Mechanics,* June 27 - July 2, 2010, State College, Pennsylvania, USA.

V. Sharma and M. Srinivasarao, "Mechanistic aspects of formation of ordered arrays of air bubbles in polymer films" *Polymer Preprints*, ACS Spring Meeting, Chicago, 2007.

Journal covers

Material Science and Engineering Reports, 65, 1 (2009).

Rheology Bulletin, 51, 3, (2010).

ACADEMIC HONORS

Selected/ invited to attend *APS Opportunities in Energy Research Workshop*, Portland, OR. 2010

Chair's travel award, *Gordon Research Conference - Polymer Physics*. 2004 & 2006

Fellowship for *ACS PRF Summer School on Nanoparticle Materials*, Ypsilanti, MI, June 2004

Travel grant, for *ACS 6th National Graduate Research Polymer Conference,* UMASS, Amherst. *2005*

National Talent Scholarship (NTSE): Awarded by National Council for Educational Research and Training, (NCERT), India to the top 750 students selected by a series of nationwide examinations. 1995-2001

Himachal Pradesh State Scholarship for Undergraduate Study in Engineering awarded for securing 3rd rank in the H. P. Engineering Entrance Examination. 1997-2001

National Science Talent Scholarship, awarded by Universal Trust. 1996 & 1997

PROFESSIONAL SERVICE

Reviewer [Journals]

Journal of Fluid Mechanics, Physical Review E, International Journal of Multiphase Flow, Applied Rheology, International Journal of Polymer Science, Soft Matter, Journal of Material Chemistry, Macromolecules, Lab on a Chip.

Session chair

Solution based processing of organic photovoltaics. AICHE Fall Meeting. Minneapolis, MN 2011

Innovations In Nanomaterials, Processes and Organics for Enhanced Carrier Generation and Extraction, AICHE Fall Meeting, Minneapolis, MN 2011

Polymer nanocomposites: Graphene MRS Fall Meeting, Boston 2010.

Jets and wakes. APS DFD (Division of Fluid Dynamics) Meeting, Long Beach, CA. 2010.

New experimental, theoretical and computational methods in polymer and soft matter physics. APS March Meeting, Portland, OR. 2010.

Professional Affiliations

American Physical Society, American Chemical Society, American Institute of Chemical Engineers, Society of Rheology, Materials Research Society, Biophysical Society.

SELECTED PRESENTATIONS*

(*31 talks out of 62 contributed talks/posters; complete list available on request)

Invited

1. V. Sharma, “Rheology of globular proteins: Apparent yield stress and interfacial viscoselasticity of bovine serum albumin solutions”, ACS Fall Meeting, Denver CO 2011.
2. V. Sharma, "Capillary break-up during jetting of weakly viscoelastic fluids," Nanotech Conference and Expo 2011, Boston 2011.
3. V. Sharma, “Life and death of a weakly viscoelastic jet: from fluid mechanics to rheometry”, Johns Hopkins University, Baltimore, MD 2011.
4. V. Sharma, “Life and death of a weakly viscoelastic jet: from fluid mechanics to rheometry”, Schlumberger Doll Research Center, Cambridge, MA 2011.
5. V. Sharma, “Rheology of globular proteins: Apparent yield stress and interfacial viscoselasticity of bovine serum albumin solutions”, MedImmune Inc, Gaithersburg, MD 2011.
6. V. Sharma, “Rheology of globular proteins: Apparent yield stress and interfacial viscoselasticity of bovine serum albumin solutions”, National Institute of Standards in Technology (NIST), Gaithersburg, MD 2011.
7. V. Sharma, “Life and death of a weakly viscoelastic jet: from fluid mechanics to rheometry”, Physical Math, Massachusetts Institute of Technology, Cambridge, MA 2011.
8. V. Sharma, “Life and death of a weakly viscoelastic jet: from fluid mechanics to rheometry”, University of Massachusetts, Amherst, MA 2011.
9. V. Sharma, “Soft Matter ODES: From life and death of a weakly viscoelastic jet to the structured color of jeweled beetles”, Georgia Institute of Technology, Atlanta, GA. 2011
10. V. Sharma, “Soft Matter ODES: From life and death of a weakly viscoelastic jet to the structured color of jeweled beetles”, Harvard Squishy Physics. 2010
11. V. Sharma, “Spraying of Complex Fluids: Structural Color and Capillary Break-up“, Procter and Gamble (P&G), Darmstadt, Germany. 2010.

Interfacial Rheology of Globular Proteins and Complex Fluids

12. V. Sharma, A. Jaishankar and G. H. McKinley, APS March Meeting, Dallas, TX. 2011
13. V. Sharma, A. Jaishankar and G. H. McKinley, AICHE Annual Meeting, Minneapolis, MN. 2011

Extensional Rheology of Complex Fluids and Particle-Filled Fluids

14. V. Sharma, K. Park, R. E. Cohen and G. H. McKinley, AICHE Annual Meeting, Minneapolis, MN. 2011
15. V. Sharma, A. M. Ardekani, J. Serdy, P. Thefrall-Holmes and G. H. McKinley, MRS Fall Meeting, Boston, MA. 2010
16. V. Sharma, A. M. Ardekani, J. Serdy, P. Thefrall-Holmes and G. H. McKinley, AICHE Annual Meeting, Utah. 2010
17. V. Sharma, J. Serdy, P. Thefrall-Holmes and G. H. McKinley, APS March Meeting, Portland, OR. 2010
18. V. Sharma, J. Serdy, P. K. Bhattacharya and G. H. McKinley, Society of Rheology Meeting, Madison, WI. 2009

Breath Figure Templated Assembly of Ordered Arrays of Bubbles in Polymer Films

19. V. Sharma and M. Srinivasarao, AICHE Annual Meeting, Utah. 2010
20. V. Sharma and M. Srinivasarao, APS March Meeting, Pittsburgh, PA. 2009
21. V. Sharma and M. Srinivasarao, 41st New England Complex Fluids Workshop, Harvard University, Cambridge, MA. Dec, 2008
22. V. Sharma and M. Srinivasarao, APS March Meeting, New Orleans, LA. 2008
23. V. Sharma and M. Srinivasarao, APS March Meeting, Denver, CO. 2007
24. V. Sharma and M. Srinivasarao, ACS March Meeting, Chicago, IL. 2007

Biophotonics/Optics: Structural color in beetles and butterflies

25. V. Sharma, M. Crne, J.O. Park, and M. Srinivasarao, MRS Fall Meeting, Boston, MA. 2010

Colloidal Hydrodynamics: Shape Separation of Gold Nanorods using Centrifugation

26. V. Sharma and M. Srinivasarao, ACS National Meeting, Atlanta, GA. March, 2006
27. V. Sharma, K. Park and M. Srinivasarao, 6th National Graduate Research Polymer Conference, UMASS Amherst, MA. June, 2005
28. V. Sharma, K. Park and M. Srinivasarao, APS March Meeting, Los Angeles, CA. 2005

Pattern formation in Evaporating Droplets of Colloidal Gold Nanorods

29. V. Sharma and M. Srinivasarao, ACS National Meeting, Atlanta, GA. March, 2006

Rheological Behavior of Slide Ring Gels

30. V. Sharma, J. S. Park, J. O. Park and M. Srinivasarao, APS March Meeting, Baltimore, MD. 2006

Opto-Microfluidics: Chaotic Mixing in Microdroplets

31. V. Sharma, R. O. Grigoriev, M. Srinivasarao and M. F. Schatz, APS Division of Fluid Dynamics 57th Annual Meeting, Seattle, WA. Nov 2004

TEACHING & MENTORING EXPERIENCE

Massachusetts Institute of Technology, Cambridge, MA

Lecturer, short course on *Polymer Physics* to graduate students and post-doctoral associates in Hatsopoulous Microfluids Laboratory, July 2008.

Research Superviser: Olivia Pessinet, a visiting graduate student from Mines Paristech Engineering School, on a project titled: *Rheological behavior of Hydrophobically Modified Ethyl Hydroxyethyl Cellulose Solutions,* July-September 2010.

Research mentor/collaborator: Aditya Jaishankar: *Shear and interfacial rheology of globular proteins and protein-surfactant mixtures,* July 2010-now.

Research mentor/collaborator: Ken Park: *Drop Impact of Complex Fluids* , Feb 2011-now.

Georgia Institute of Technology, Atlanta, GA

Guest Lecturer, in undergraduate and graduate course on *Physical Chemistry of Polymer Solutions* offered by Prof. Mohan Srinivasarao, 2004-2008

Instructor, for an undergraduate laboratory course *Structure Properties of Polymers/Fibers*. Spring 2006

Research Mentor: Sai M. Gogineni, undergraduate student on *Ordered and disordered patterns formed during breath figure templated assembly*.

University of Akron, Akron, OH

Instructor, taught high school students *Mathematics & Computer Skills* in the Upward Bound Math/Science Summer Program, Summer 2002.

Teaching Assistant, graduate course *Polymer Science Laboratory*,. 2001-2002

Indian Institute of Technology, Delhi, India

Voluntarily taught underprivileged kids alphabet in slums of Old Delhi. May 1999
Teacher: Taught mathematics to grade X students, St. Mary's Convent, Kasauli. June 1999

LITERARY PUBLICATIONS & HONORS

<u>Book</u>: *Saga of a Crumpled Piece of Paper (63 Poems, English) Writers Workshop, Calcutta*, 2009.

<u>Refereed journals</u>: (Selected list) (English >30 published) *Poetry*; *The Cortland Review*; *Atlanta Review*; *Bateau*; *Mythium*; *Breakwater Review, Muse India* among others. (Hindi) *Aakhar*, *Himachal Mitra, etc.*

Newspaper articles and poetry in Hindi: Divya Himachal, India (2007-2010). Specifically aimed at inspiring students in my home state, Himachal to pursue knowledge & drive social change through education; written at the request of *My Himachal*, an NGO working in the Himalayas, India.

Nominated for Pushcart Prize in poetry, 2008.

Awarded scholarship (3 times) to present poetry & attend 13th, 14th & 15th *Sarah Lawrence Summer Seminar for Writers*, New York, in 2006, 2007 & 2008.

REFERENCES

Gareth McKinley, Professor and Associate Head, Department of Mechanical Engineering, Massachusetts Institute of Technology, 77 Massachusetts Ave, Bldg 3-252, Cambridge, MA 02139 email: gareth@mit.edu 617-258-0754.

Mohan Srinivasarao, Professor, School of Materials Science and Engineering & School of Chemistry and Biochemistry, MRDC 1, 801 Ferst Dr., Georgia Institute of Technology, Atlanta, GA 30332 email: **mohan@mse.gatech.edu** 404-894-9348.

Ali Dhinojwala, Morton Professor of Polymer Science and Chair, Department of Polymer Science, University of Akron, Akron, OH 44325-3909 email: **ali4@uakron.edu** (330) 972-6246

M. F. Schatz, Associate Professor, Center for Nonlinear Sciences & School of Physics, Georgia Institute of Technology, Atlanta, GA 30332 email: **mike.schatz@physics.gatech.edu** 678-595-5577.

William J. Koros, Roberto C. Goizueta Chair and Georgia Research Alliance Eminent Scholar in Membranes, School of Chemical and Biochemical Engineering, 311 Ferst Drive, N.W., Georgia Institute of Technology, Atlanta, GA 30332 email: **wjk@chbe.gatech.edu** 404-385-2845.