



Monash University

CFMW08 Complex Fluids & Microfluidics Workshop 2008

Introduction

The Complex Fluids and Microfluidics Workshop 2008 (CFMW08), held in Melbourne, Australia is the first of what we hope to be a regular series of workshops on complex fluids and microfluidics. The aim of this workshop is to comprise of an informal gathering of researchers working in complex fluids and microfluidics with the primary purpose of providing a forum for cross-fertilisation of ideas on current advances and future directions in these areas.

We have deliberately intended the scope of the workshop to be fairly broad along the central themes of complex fluids and microfluidics, including polymeric liquids, colloidal suspensions, physiological/biological fluids, granular materials and surfactant-laden systems under the general umbrella of complex fluid systems, and, fluid actuation, droplet transport, pathogen/biomolecule concentration, micro-mixing, separation, bioparticle sorting, DNA manipulation being amongst the various motifs under the general micro/nanofluidics theme.

Eight of the most prominent researchers in complex fluids and microfluidics have kindly agreed to deliver keynote lectures, which will constitute the plenary sessions on various topics falling under the scope of the workshop above. In addition, two panel discussion sessions will be conducted to exchange ideas amongst workshop delegates and the panel members on perspectives on future directions in both subject areas.

We hope that this first Complex Fluids and Microfluidics Workshop will be extremely beneficial in terms of stimulating further developments in these research areas as well as facilitating new collaborative networks between workshop delegates. Please provide us with your feedback at the end of the workshop. It is certainly our hope that this will not be the last of such workshops.

We would like to thank all the speakers for taking the time out of their hectic schedules to deliver keynote lectures and to all delegates for their participation. We are also extremely grateful to the many people who have contributed to the organisation of the workshop and to our sponsors, without whom the workshop would not have materialised.

Welcome to Melbourne!

Leslie Yeo

Ravi Prakash Jagadeeshan

James Friend

Workshop Programme

Monday 1 September 2008

8.30 am - 9.00 am	Registration
9.00 am - 9.15 am	Welcome
9.15 am - 10.15 am	Professor John Brady (California Institute of Technology, USA) <i>Single particle motion in colloids: Microrheology and microdiffusivity</i>
10.15 am - 11.15 am	Professor Andrew Kraynik (Sandia National Laboratories, USA) <i>Foam structure and rheology: The shape and feel of random soap froth</i>
11.15 am - 11.45 am	Tea/Coffee break
11.45 am - 12.45 pm	Professor Gary Leal (University of California, Santa Barbara, USA) <i>Linear and nonlinear rheology of entangled, flexible polymers that are highly branched</i>
12.45 pm - 2.30 pm	Lunch break
2.30 pm - 3.30 pm	Professor Eric Shaqfeh (Stanford University, USA) <i>What can we learn about nonequilibrium reptation from single molecule experiments and slip-link simulations?</i>
3.30 pm - 4.30 pm	Professor Nadine Aubry (Carnegie Mellon University, USA) <i>Electric field induced phenomena in micro-flows: Mixing, particle manipulation and self-assembly</i>
4.30 pm - 5.00 pm	Tea/Coffee break
5.00 pm - 6.00 pm	Open forum/Discussion

Tuesday 2 September 2008

9.00 am - 10.00 am	Professor Sriram Ramaswamy (Indian Institute of Science, Bangalore, India) <i>Thin-film instabilities of active suspensions</i>
10.00 am - 11.00 am	Professor Oliver Jensen (University of Nottingham, UK) <i>Hydrodynamic interactions between deformable interfaces</i>
11.00 am - 11.30 am	Tea/Coffee break
11.30 am - 12.30 pm	Professor Justin Cooper-White (University of Queensland, Australia) <i>Elastic instabilities in entry flows: A consequence of upstream stretch or downstream relaxation?</i>
12.30 pm - 1.30 pm	Open forum/Discussion

Workshop Speakers



Professor Nadine Aubry (Department of Mechanical Engineering, Carnegie Mellon University, USA)

Dr Nadine Aubry is Professor and Head of the Department of Mechanical Engineering at Carnegie Mellon University where she conducts research in the area of fluid dynamics. She pioneered the modeling of open flow turbulence and other complex flows using advanced decomposition tools and dynamical systems theory. Her current group's research focuses on microscale flows that she manipulates using electric fields. Particularly, her team has proposed new techniques for effective mixing, droplet generation, the manipulation of particles suspended in liquids and the assembly of micro- and nano-sized neutral particles at fluid-fluid interfaces into two-dimensional arrays (monolayers). Dr Aubry's awards include the Presidential Young Investigator Award from the National Science Foundation (NSF), and her election as Fellow of the American Physical Society (APS), Fellow of the American Society of Mechanical Engineers (ASME), Fellow of the American Association for the Advancement of Science (AAAS), and Senior Member of the American Institute of Aeronautics and Astronautics (AIAA). She currently serves as Chair of the US National Committee for Theoretical and Applied Mechanics (USNC/TAM).

Workshop Speakers



Professor John Brady (Department of Chemical Engineering, California Institute of Technology, USA)

Professor John F. Brady received his BS in chemical engineering from the University of Pennsylvania in 1975 and spent the next year at Cambridge University as a Churchill Scholar. He received both an MS and a PhD in chemical engineering from Stanford University, the latter in 1981. Following a postdoctoral year at the Ecole Supérieure de Physique et de Chimie Industrielles, he joined the Chemical Engineering department at MIT. Professor Brady moved to Caltech in 1985. Professor Brady's research interests are in the mechanical and transport properties of two-phase materials, especially complex fluids such as biological liquids, colloid dispersions, suspensions, and porous media. His research takes a multilevel approach and combines elements of statistical and continuum mechanics to understand how macroscopic behavior emerges from microscale physics. He is particularly noted for the invention of the Stokesian Dynamics technique for simulating the behavior of particles dispersed in a viscous fluid under a wide range of conditions. Professor Brady has been recognized for his work by many awards, including a Presidential Young Investigator Award, a Camille and Henry Dreyfus Teacher-Scholar Award, the ASEE Curtis W. McGraw Research Award, and the Corrsin and Batchelor lectureships in fluid mechanics. He is a fellow of the American Physical Society and a member of the National Academy of Engineering.

Workshop Speakers



Professor Justin Cooper-White (Australian Institute for Bioengineering & Nanotechnology, University of Queensland, Australia)

Professor Justin Cooper-White received his PhD at the University of Queensland in 2000. His research interests are in biomaterials processing, tissue engineering, non-Newtonian fluid mechanics, rheology and microfluidics. Specifically, his research group at the Tissue Engineering and Microfluidics (TEAM) Laboratory has projects in all of these areas with a common focus of providing fundamental insight into complex polymer-based structures and systems, with the aim of ultimately tailoring and controlling their interactions with biological systems. These projects are investigating novel methods of manufacturing polymeric scaffolds and methods of surface engineering of these scaffolds for drug delivery and tissue engineering applications, new in vitro modules for mapping cell-surface and cell-scaffold interactions, manufacturing functional microparticles with micro processing plants and complex fluid behaviour in microdevices.

Workshop Speakers



Professor Oliver Jensen (School of Mathematical Sciences, University of Nottingham, UK)

Professor Oliver Jensen is Professor of Applied Mathematics and Head of the School of Mathematical Sciences at the University of Nottingham. He is co-editor of the journal *Mathematical Medicine & Biology*, associate editor of the *Journal of Fluid Mechanics* and member of the editorial board of the *Proceedings of the Royal Society A*. His research involves the application of continuum mechanics and mathematical modelling to topics in physiology and medicine. Professor Jensen's current research encompasses cell adhesion and motility, soft tissues, hydrodynamics in microscopy, pulmonary airway mechanics, flow in collapsible tubes and its stability to self-excited oscillations, spreading of surfactants on viscous fluids and transport in physiological systems.

Workshop Speakers



Professor Andrew Kraynik (Sandia National Laboratories, USA)

Andy received a BS in Chemical Engineering from Carnegie-Mellon University in 1972 and a PhD from Princeton in 1976 under the supervision of Prof. William R. Schowalter. He then joined Sandia National Laboratories in Albuquerque, New Mexico, where he has worked ever since. Andy is currently Past President of the Society of Rheology and serves as the U.S. Delegate to the International Committee on Rheology. He received the Distinguished Service Award of the Society in 2001. His research has focused on foam micromechanics—the rheology of liquid foam, mechanics of solid foam, structure, drainage, and processing. He has also worked in polymer processing, non-Newtonian fluid mechanics, and rheometry (co-developer of the helical screw rheometer).

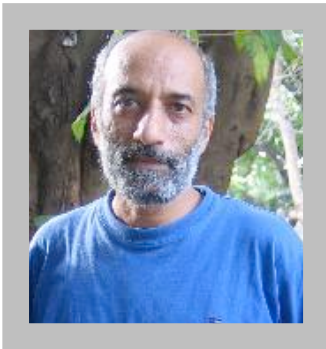
Workshop Speakers



Professor Gary Leal (Department of Chemical Engineering, University of California, Santa Barbara, USA)

Professor Gary Leal is Warren and Katherine Schlinger Professor of Chemical Engineering and Chair of the Department of Chemical Engineering at the University of California, Santa Barbara where he conducts research on the dynamics of complex fluids, such as polymeric liquids, emulsions, foams, polymer blends, and liquid crystalline polymers (LCPs). Much of this is related to the coupling between the influence of flow on the microstructure of these materials, and hence on the macroscopic material properties. Within this broad framework, Professor Leal is working on: coalescence phenomena; the dynamics of thin liquid films and the control of the stability of such films due to additives such as copolymer surfactants, and nano- or micro-particles; the flow behavior of LCPs, including the formation of disclinations; and the dynamics of entangled polymers. Professor Leal is the recipient of the American Physical Society Fluid Dynamics prize, the Society of Rheology Bingham medal and the AIChE Allan Colburn award; he is currently the editor of *Physics of Fluids* and is the John Simon Guggenheim Foundation Fellow, Fellow of the American Physical Society and a member of the National Academy of Engineering.

Workshop Speakers



Professor Sriram Ramaswamy (Department of Physics, Indian Institute of Science, Bangalore, India)

Professor Sriram Ramaswamy received his BS from the University of Maryland and PhD from the University of Chicago and is currently Professor at the Centre for Condensed Matter Theory in the Department of Physics, Indian Institute of Science, Bangalore. His research interests are in the statistical mechanics and dynamics of soft and biological matter, for example that of sedimentation and electrophoresis, dynamics and rheological chaos in surfactant solutions, ordered non-equilibrium states in agitated monolayers of granular rods and the hydrodynamics of self-driven organisms. Professor Ramaswamy has held a number of visiting positions including that at the Kavli Institute of Theoretical Physics, the Isaac Newton Institute, the Hahn-Meitner Institute Berlin, the Centre de Recherche Paul Pascal, Ecole Supérieure de Physique et de Chimie Industrielles Paris, IBM Yorktown and the Institute for Theoretical Physics at the University of California Santa Barbara. He has also received numerous awards such as the JC Bose Fellowship, the GD Birla Prize for Science, the Shanti Swarup Bhatnagar Prize for Physical Sciences, the NASI Young Scientist Millennium Award, the BM Birla Memorial Prize for Physics and the NS Satyamurthy Award and has been elected as a Fellow of the Indian National Science Academy and as an Associate of the Indian Academy of Sciences. Professor Ramaswamy currently sits in the editorial boards of *Advances and Physics*, the *Journal of Statistical Mechanics: Theory and Experiment*, and *Soft Matter* and has previously been member of the editorial boards of *Physical Review E*, *Liquid Crystals*, *Current Science* and *Resonance*.

Workshop Speakers



Professor Eric Shaqfeh (Department of Chemical Engineering, Stanford University, USA)

Professor Eric Shaqfeh received his BSE in Chemical Engineering from Princeton University, and, MS and PhD degrees in Chemical Engineering from Stanford University under the advice of Professor Andreas Acrivos. In 1986, he was awarded a NATO Postdoctoral Fellowship for postdoctoral work in the Department of Applied Mathematics and Theoretical Physics at Cambridge University in England. He began his career at Stanford University in 1990 where he currently holds a dual appointment as Professor of Mechanical Engineering and Associate Chair of Chemical Engineering. Professor Shaqfeh has received a number of professional awards including the APS Francois N. Frenkiel Award 1989, the NSF Presidential Young Investigator Award 1990, the David and Lucile Packard Fellowship in Science and Engineering 1991, the Camille and Henry Dreyfus Teacher-Scholar Award 1994, the W.M. Keck Foundation Engineering Teaching Excellence Award 1994, and the 1998 Curtis W. McGraw Award from the American Society of Engineering Education. His professional lectureships include the Thiele Lectureship at Notre Dame in 1999, the Van Ness Lectureship at RPI in 2001, the Merck Distinguished Lectureship at Rutgers in 2003, the Corrsin Lectureship at Johns Hopkins in 2003 and the Katz Lectureship at CCNY in 2004. He was also the Hougen Professor of Chemical Engineering at the University of Wisconsin in 2004. In 2000, Professor Shaqfeh was inducted as a Fellow of the American Physical Society and has served as an Associate Editor of Physics of Fluids since 2006. He has authored or co-authored over 120 publications in areas including non-Newtonian fluid mechanics (especially in the area of elastic instabilities, and turbulent drag reduction), nonequilibrium polymer statistical dynamics (focusing on single molecules studies of DNA), and suspension mechanics (particularly of fiber suspensions and composites).

Organisers



Dr Leslie Yeo (Micro/Nanophysics Research Laboratory, Monash University, Australia)

Leslie Yeo is a Senior Lecturer in Mechanical & Aerospace Engineering at Monash University, Australia. His research interests are in microfluidics and interfacial flow phenomena, in particular, the use of acoustic and electric fields for fluid actuation and particle manipulation at micron and nanometer scales. Leslie is the recipient of the 2007 Young Tall Poppy Science Award and is the Associate Editor of Biomicrofluidics.



Dr Ravi Jagadeeshan (Department of Chemical Engineering, Monash University, Australia)

Ravi Prakash Jagadeeshan is a Reader in Chemical Engineering at Monash University. Ravi's research interests revolve around understanding the interaction of flow and micro-structure in complex fluids. Ravi and his students use an array of modeling techniques including non-equilibrium Brownian Dynamics, closure approximations, and finite element analysis. Ravi is the 2006-2008 President of the Australian Society of Rheology and the Editor of the Korea Australia Rheology Journal.



A/Prof James Friend (Micro/Nanophysics Research Laboratory, Monash University, Australia)

James Friend is an Associate Professor and Deputy Head of Department in Mechanical & Aerospace Engineering at Monash University, Australia. James' current research interests are in micro and nano phenomena and their use in applications, particularly in acoustics and its coupling in solid/solid and solid/fluid interfaces to form microactuators, pumps, sensors, and particle manipulation devices. He is co-director with Leslie Yeo of the Micro/Nanophysics Research Laboratory at Monash University.

Workshop Delegates

Name	Affiliation	Email
Paulo Arratia	University of Pennsylvania	parratia@seas.upenn.edu
Peter Asimakis	University of Melbourne	asip@unimelb.edu.au
Edwin Baez	RMIT University	edwin.baez@rmit.edu.au
Erwan Bertevas	University of Sydney	erwan.bertevas@aeromech.usyd.edu.au
Gary Bryant	RMIT University	gary.bryant@rmit.edu.au
Andrew Campitelli	MiniFab	andrewcampitelli@minifab.com.au
Debadi Chakraborty	Monash University	debadi.chakraborty@eng.monash.edu.au
Nikko Chan	University of Melbourne	nikkoc@unimelb.edu.au
Andrew Chyss	RMIT University	andrew.chyrs@rmit.edu.au
Richard Clarke	University of Auckland	rj.clarke@auckland.ac.nz
Peter Daivis	RMIT University	peter.daivis@rmit.edu.au
Malcolm Davidson	University of Melbourne	m.davidson@unimelb.edu.au
Minh Do-Quang	Royal Institute of Technology, Stockholm	minh@mech.kth.se
Dave Dunstan	University of Melbourne	davided@unimelb.edu.au
Raymond Guang	RMIT University	raymond.guang@rmit.edu.au
Jia-Hong Guo	Shanghai Institute of Applied Mathematics & Mechanics	jhgao@staff.shu.edu.cn
Rahul Gupta	RMIT University	rahul.gupta@rmit.edu.au
Ronald Halim	Monash University	ronald.halim@eng.monash.edu.au
Jesper Hansen	Swinburne University of Technology	jehansen@swin.edu.au
Oliver Harlen	University of Leeds	oliver@maths.leeds.ac.uk
Chris Honig	University of Melbourne	c.honig@pgrad.unimelb.edu.au
Guo-Hui Hu	Shanghai Institute of Applied Mathematics & Mechanics	hu_guohui@126.com
Sasikaran Kandaswamy	Monash University	sasikaran.kandasamy@eng.monash.edu.au
Christian Karnutsch	University of Sydney	c.karnutsch@physics.usyd.edu.au
Saif Khan	National University Singapore	chesakk@nus.edu.sg
Betty Khanmohamadi	Monash University	batool.khanmohammadi@eng.monash.edu.au

Name	Affiliation	Email
Lingxue Kong	Deakin University	lingxue.kong@deakin.edu.au
Christian Kugge	CSIRO Forest Biosciences	christian.kugge@csiro.au
Pandurang Kulkarni	City College New York	pmkulkarni@gmail.com
Tu Le	Swinburne University of Technology	tle@groupwise.swin.edu.au
Nicole Lebo	Monash University	nicole.lebo@eng.monash.edu.au
Adrian Lekay	RMIT University	s3081641@student.rmit.edu.au
Justin Leontini	Monash University	justin.leontini@eng.monash.edu.au
Weihua Li	University of Wollongong	weihuali@uow.edu.au
Haiyan Li	Monash University	haiyan.li@eng.monash.edu.au
Daniel Liu	Monash University	daniel.liu@eng.monash.edu.au
David LoJacono	Monash University	david.lojacono@eng.monash.edu.au
Alex Lubansky	University of Swansea	a.s.lubansky@swansea.ac.uk
Fredrik Lundell	Royal Institute of Technology, Stockholm	fredrik@mech.kth.se
Vincent Martinez	RMIT University	vincent.martinez@student.rmit.edu.au
Geordie McBain		
Catherine Meriaux	Monash University	catherine.meriaux@sci.monash.edu.au
Anton Middelberg	University of Queensland	a.middelberg@uq.edu.au
Nicholas Miller	RMIT University	nicholas.miller@rmit.edu.au
Akio Nakahara	Nihon University	nakahara@kf6.so-net.ne.jp
Chiara Neto	University of Sydney	c.neto@chem.usyd.edu.au
Thanh Nguyen	Monash University	thanh.h.nguyen@eng.monash.edu.au
Stefano Oberti	ETH Zurich	stefano.oberti@imes.mavt.ethz.ch
Philip Palma		
Kuo-Long Pan	National Taiwan University	panpeter@ntu.edu.tw
Kamlesh Patel	Monash University	kamlesh.patel@eng.monash.edu.au
Karolina Petkovic	CSIRO	karolina.petkovicduran@csiro.au
Harald Pleiner	MPI Polymer Research, Germany	pleiner@mpip-mainz.mpg.de
Frank Plouraboue	CNRS Institut de Mecanique des Fluides	plourab@imft.fr
Craig Priest	Ian Wark Research Institute	craig.priest@unisa.edu.au
Ruslan Puscasu	Swinburne University of Technology	rpuscasu@ict.swin.edu.au
Aisha Qi	Monash University	aisha.qi@eng.monash.edu.au
Rohan Raghavan	Monash University	rohan.raghavan@eng.monash.edu.au
Sumanta Raha	RMIT University	sumanta.raha@rmit.edu.au
Prabhakar Ranganathan	Monash University	prabhakar.ranganathan@eng.monash.edu.au

Name	Affiliation	Email
Paul Reichl		
Fatame Rezaei	Monash University	fateme.rezaei@eng.monash.edu.au
Srabon Salim	Monash University	srabon.mms@eng.monash.edu.au
Matthias Schuenemann	MiniFab	matthiasschuenemann@minifab.com.au
Mathieu Sellier	University of Canterbury	mathieu.sellier@canterbury.ac.nz
Ilya Semenov	Russian Academy of Sciences	semenov@icad.org.ru
John Sheridan	Monash University	john.sheridan@eng.monash.edu.au
Richie Shilton	Monash University	richard.shilton@eng.monash.edu.au
Lisa Smith	University of Melbourne	l.smith13@pgrad.unimelb.edu.au
Rachel Smith	Monash University	rachel.smith@eng.monash.edu.au
Ian Snook	RMIT University	ian.snook@rmit.edu.au
Matthew Solomon	MiniFab	matthewsolomon@minifab.com.au
Rudolf Spehar	University of Melbourne	r.spehar@pgrad.unimelb.edu.au
Ming Tan	Monash University	ming.tan@eng.monash.edu.au
Melvin Tan	Monash University	melvin.tan@eng.monash.edu.au
Quanzhi Teng	University of Wollongong	qt930@uow.edu.au
Nyomi Uduman	Monash University	nyomi.uduman@eng.monash.edu.au
Bill Van Megen	RMIT University	bill.vanmegen@rmit.edu.au
Zhongwu Zhou	RMIT University	zhongwu.zhou@rmit.edu.au
Chunxia Zhou	Australian Institute of Bioengineering & Nanotechnology	z.chunxia@uq.edu.au
Eyal Zussman	Technion Institute of Technology, Israel	meeyal@tx.technion.ac.il

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