FY 2024 Annual Report

Unit Name

Micro/Bio/Nanofluidics Unit

Collaborations

Ashis K Sen, IIT Madras, India, Understanding the role of loss modulus of viscoelastic substrates in the evaporation dynamics of sessile drops

Yuanyuan Guo, Tohoku University,, Japan, Twisted fiber microfluidics: a cutting-edge approach to 3D spiral devices

Riccardo Funari, Scuola Superiore Sant'Anna, Italy, Multiplexed opto-microfluidic biosensing: advanced platform for prostate cancer detection

Pranab Kumar Mondal, IIT Guwahati, India, Multiple projects

Atsushi Matsumoto, University of Fukui, Japan, Multiple projects

Carlos Lopez, The Pennsylvania State University, USA, Multiple projects

Marco E. Rosti, OIST, Japan, Multiple projects

Paola Laurino, OIST, Japan, Multiple projects

Gareth McKinley, MIT, USA, Multiple projects

Nikhil Bhalla, University of Ulster, UK, Localized Surface Plasmon Resonance Sensing and its Interplay with Fluidics

Hsieh-Fu Tsai, CGU BME Taiwan, Taiwan, Impact of dcEF on microRNA profiles in glioblastoma and exosomes using a novel microfluidic bioreactor

Nicholas W. Turner, The University of Sheffield, UK, Enzyme Activity Inhibition of α-Amylase Using Molecularly Imprinted Polymer (MIP) Hydrogel Microparticles

Research Personnel

Simon Haward, Senior Staff Scientist

Mark Sullivan , Staff Scientist

Steffen Michael Recktenwald, Staff Scientist

Vincenzo Calabrese , Staff Scientist

Perrine Lasserre, Postdoctoral Scholar

Ricardo Arturo Lopez de la Cruz, Postdoctoral Scholar

Kazumi Toda-Peters , Research Unit Technician

Yuto Yokoyama, JSPS Postdoc Fellow

Kohei Abe, JSPS Postdoc Fellow

Hiromu Josha, RUA

Fabian Hillebrand, PhD Student

Rios Maciel Mauricio Andres, PhD Student

Arisa Yokokoji, PhD Student

Bosch Tamayo Teresa, PhD Student

Jiangming Wu, PhD Student

Iakimova Tamara, PhD Student

Scholarly Contributions and Creative Productions (by Faculty)

Conference Proceedings

1. Shen, A. Q.
   [Chair]PI Session IV: Stem Cell, Development, and Tissue

Journal Article

1. Dindo, M.; Bevilacqua, A.; Soligo, G.; Calabrese, V.; Monti, A.; Shen, A. Q.; Rosti, M. E.; Laurino, P.
   Chemotactic Interactions Drive Migration of Membraneless Active Droplets
   Journal of the American Chemical Society 2024, 146, 15965–15976.
   http://dx.doi.org/10.1021/jacs.4c02823
2. Funari, R.; Chu, K.; Shen, A.
   Multiplexed Opto-Microfluidic Biosensing: Advanced Platform for Prostate Cancer Detection
   ACS Sensors 2024, 9, 2596–2604.
   https://dx.doi.org/10.1021/acssensors.4c00312
3. Calabrese, V.; Porto Santos, T.; Lopez, C.; Lettinga, M.; Haward, S.; Shen, A.
   Extensibility Governs the Flow-Induced Alignment of Polymers and Rod-like Colloids
   Physical Review Research 2024, 6, L012042.
   https://dx.doi.org/10.1103/PhysRevResearch.6.L012042
4. Iqbal, R.; Matsumoto, A.; Shen, A.; Sen, A.
   Understanding the Role of Loss Modulus of Viscoelastic Substrates in the Evaporation Dynamics of Sessile Drops
   Langmuir 2024, 40, 10035–10043.
   https://dx.doi.org/10.1021/acs.langmuir.4c00191
5. Lopez de la Cruz, R. A.; Haward, S. J.; Shen, A. Q.
   Canopy Elastic Turbulence: Insights and Analogies to Canopy Inertial Turbulence. PNAS Nexus 2025, 4, 571.
   https://doi.org/10.1093/pnasnexus/pgae571
6. Abdelgawad, M.; Haward, S.; Shen, A.; Rosti, M.
   The Interplay of Plasticity and Elasticity in Elastoviscoplastic Flows in Wavy Channels
   Physics of Fluids 2024, 36, 113127.
   https://dx.doi.org/10.1063/5.0239451
7. Fiore, L.; Mazzaracchio, V.; Antinucci, A.; Ferrara, R.; Sciarra, T.; Lista, F.; Shen, A.; Arduini, F.
   Wearable Electrochemical Device Based on Butterfly-like Paper-Based Microfluidics for pH and Na+ Monitoring in Sweat
   Microchimica Acta 2024, 191, 580.
   https://dx.doi.org/10.1007/s00604-024-06564-1
8. Kuleshova, A.; Koriakina, I.; Lubimova, A.; Timofeeva, M.; Gunina, E.; Bogdanov, K.; Reznik, I.; Povarov, S.; Khubezhov, S.; Guzei, D.; Minakov, A.; Toda-Peters, K.; Shen, A.; Milichko, V.; Zyuzin, M.
   Continuous Fabrication of MOF-Based Memory Elements via Droplet Microfluidic Synthesis
   Journal of Materials Chemistry A 2024, 12, 29776–29784.
   https://dx.doi.org/10.1039/d4ta03126a
9. Calabrese, V.; Shen, A.; Haward, S.
   How Do Polymers Stretch in Capillary-Driven Extensional Flows?

Macromolecules 2024, 57, 9668–9676.
https://dx.doi.org/10.1021/acs.macromol.4c01604

10. Winder, C.; Blackburn, C.; Hutchinson, C.; Shen, A.; Turner, N.; Sullivan, M.
Enzyme Activity Inhibition of α-Amylase Using Molecularly Imprinted Polymer (MIP) Hydrogel Microparticles
Biomacromolecules 2024, 25, 7459–7465.
https://dx.doi.org/10.1021/acs.biomac.4c01097
11. Tsai, H.; Shen, A.
Impact of dcEF on microRNA Profiles in Glioblastoma and Exosomes Using a Novel Microfluidic Bioreactor
Biomicrofluidics 2024, 18, 064106.
https://dx.doi.org/10.1063/5.0228901
12. Abdelgawad, M. S.; Haward, S. J.; Shen, A. Q.; Rosti, M. E.
From Yield Stress to Elastic Instabilities: Tuning the Extensional Behavior of Elastoviscoplastic Fluids
PNAS Nexus 2024, 3, 227.
http://dx.doi.org/10.1093/pnasnexus/pgae227
13. Mehta, S.; Deb, D.; Nandy, A.; Shen, A.; Mondal, P.
Maximizing Blue Energy: The Role of Ion Partitioning in Nanochannel Systems
Physical Chemistry Chemical Physics 2024, 26, 20550–20561.
https://dx.doi.org/10.1039/d4cp01671h
14. Jaligam, M.; Takahashi, C.; Heidt, B.; Shen, A.
Enhanced Antibacterial Efficacy: Rapid Analysis of Silver-Decorated Azithromycin-Infused Soluplus® Nanoparticles against E. Coli and S. Epidermidis Biofilms
Nanoscale 2024, 16, 17877–17885.
https://dx.doi.org/10.1039/d4nr02583k
15. Varchanis, S.; Younes, E.; Haward, S.; Shen, A.
Emergence of Lobed Wakes during the Sedimentation of Spheres in Viscoelastic Fluids
Journal of Fluid Mechanics 2024, 992, A14.
https://dx.doi.org/10.1017/jfm.2024.459
16. Hillebrand, F.; Varchanis, S.; Hopkins, C. C.; Haward, S. J.; Shen, A. Q.
Flow of Wormlike Micellar Solutions over Concavities
Soft Matter 2024, 7133–7146.
https://doi.org/10.1039/D4SM00594E
17. Zhang, T.; Carlo, D. D.; Lim, C. T.; Zhou, T.; Tian, G.; Tang, T.; Shen, A. Q.; Li, W.; Li, M.; Yang, Y.; Goda, K.; Yan, R.; Lei, C.; Hosokawa, Y.; Yalikun, Y.
Passive Microfluidic Devices for Cell Separation
Biotechnology Advances 2024, 71, 108317.
https://doi.org/10.1016/j.biotechadv.2024.108317
18. Kato, S.; Carlson, D. W.; Shen, A. Q.; Guo, Y.
Twisted Fiber Microfluidics: A Cutting-Edge Approach to 3D Spiral Devices
Microsystems & Nanoengineering 2024, 10, 14.
https://doi.org/10.1038/s41378-023-00642-9
19. Iakimova, T.; Heidt, B.; Shen, A.
Surface-Imprinted Polymers Based on 3D Printing Resin for Selective Bacteria Detection
Cell Reports Physical Science 2024, 5, 101853.
https://dx.doi.org/10.1016/j.xcrp.2024.101853
20. Bhalla, N.; Shen, A. Q.

Localized Surface Plasmon Resonance Sensing and Its Interplay with Fluidics
Langmuir 2024, 40, 9842–9854.
https://doi.org/10.1021/acs.langmuir.4c00374

Patent and Intellectual Property

1. Shen, A. Q.; Calabrese, V.; London, H.
   Precision-Controlled Fluidic Cell for Generating Extensional Flows. OIST0258-JP, 2025.

Presentation at Conference

1. Shen, A. Q.
   Microfluidics and Biosensors: Unlocking New Possibilities in Biophysics and Diagnostics. Microfluidics for Biomedical Innovation 2025 2025.
2. Shen, A. Q.
   Discovering Serendipity: Viscoelastic Instabilities, Microfluidics, and Their Interdisciplinary Applications (plenary). FLOW Annual Meeting 2025.
3. Shen, A. Q.
   Advancing Population Genetics and Disease Detection through Microfluidics and Lab-on-a-Chip Technologies. WPI-NanoLSI joint meeting with OIST.
4. Shen, A. Q.
   Unveiling Viscoelastic Instabilities and Colloidal Rod Alignment in Microfluidic Platforms. 13th International Colloids Conference 2024.
5. Shen, A. Q.
   New Opportunities to Study Population Genetics and Detect Diseases by Employing Microfluidics and Lab-Ona-Chip Devices (keynote). International workshop on bioengineering.

Seminars

1. Shen, A. Q.
   Viscoelastic Instabilities in Microfluidic Flows, Department of Physics, University of Vienna in Austria, April 2024.
2. Shen, A. Q.
   New Opportunities to Study Population Genetics and Detect Diseases by Employing Microfluidics and Lab-on-a-Chip Devices, Department of Macromolecular Science, Fudan University in China, April 2024.
3. Shen, A. Q.
   New Opportunities to Study Population Genetics and Detect Diseases by Employing Microfluidics and Lab-on-a-Chip Devices, NAIST in Japan, July 2024.
4. Shen, A. Q.
   New Opportunities to Study Population Genetics and Detect Diseases by Employing Microfluidics and Lab-on-a-Chip Devices, ShanghaiTech Univ. in China, July 2024.
5. Shen, A. Q.
   Microfluidics and Biosensors: Unlocking New Possibilities in Biophysics and Diagnostics, Department of Chemistry, University of Tokyo in Japan, December 2024.
6. Shen, A. Q.
   Innovative Microfluidic Platforms: From Viscoelastic Fluid Dynamics to Advanced Biosensing, City University of Hong Kong in Hong Kong, February 2025.

Scholarly Contributions (For Unit Members Only)

Name of Unit Member (Author-Presenter)	Type	Title	Outlet	Term
Teresa Bosch Tamayo	Poster Presentation at Conference	The design and production of high-affinity nanoparticles for Lab-on-a-chip diagnostics: The next generation of synthetic recognition materials	SelectBIO Lab-on-a-Chip, Microfluidics & Organ-on-a-Chip Asia 2024 conference	Term 1 2024
Steffen Recktenwald	Poster Presentation at Conference	Morphology, repulsion, and ordering of red blood cells in viscoelastic confined flows	95th Annual Meeting of The Society of Rheology	Term 1 2024
Kohei Abe	Poster Presentation at Conference	Deformation and coalescence kinetics of particle-stabilized droplets in drying suspensions	16th HOPE Meeting	Term 2 2024
Tamara Iakimova	Poster Presentation at Conference	Surface imprinted polymers based on 3D printing resin for selective bacteria detection	SelectBIO Lab-on-a-Chip, Microfluidics & Organ-on-a-Chip Asia 2024 conference	Term 1 2024
Tamara Iakimova	Poster Presentation at Conference	Surface imprinted polymers based on 3D printing resin for selective bacteria detection	COI-NEXT Annual Symposium	Term 2 2025
Simon Haward	Poster Presentation at Conference	Exploring multi-stability in three-dimensional viscoelastic flow around a free stagnation point	BSR Midwinter Meeting	Term 1 2024
Simon Haward	Poster Presentation at Conference	Flow of wormlike micellar solutions over concavities	95th Annual Meeting of The Society of Rheology	Term 1 2024
Simon Haward	Poster Presentation at Conference	Exploring multi-stability in three-dimensional viscoelastic flow around a free stagnation point	95th Annual Meeting of The Society of Rheology	Term 1 2024
Simon Haward	Poster Presentation at Conference	How do polymers stretch in capillary-driven extensional flows?	AERC, Leeds	Term 2 2024
Steffen Recktenwald	Poster Presentation at Conference	Large Amplitude Oscillatory Extension (LAOE) – Characterizing the non-linear stress response of viscoelastic fluids during elongation	14th International Gel Symposium	Term 1 2024
Ricardo Arturo Lopez de la Cruz	Poster Presentation at Conference	Characterization of inertialess viscoelastic canopy flows	Researcher Appreciation Month 2024	Term 1 2024
Steffen Recktenwald	Poster Presentation at Conference	Large Amplitude Oscillatory Extension (LAOE) of complex fluids in planar elongation	95th Annual Meeting of The Society of Rheology	Term 1 2024
Arisa Yokokoji	Poster Presentation at Conference	Hydrodynamic interactions between viscoelastic fluid and biomimetic cilia-like structures	APS DFD 2024	Term 1 2024
Jiangming Wu	Poster Presentation at Conference	Enhancing Rheology and Printability of Fruit and Vegetable-Based Inks with Microalgae-Derived Polysaccharides for 3D Food Printing	The Society of Rheology 95th Annual Meeting	Term 1 2024
Mark Sullivan	Poster Presentation at Conference	Low-Cost Cortisol Detection for Stress Monitoring	COI-Next Annual Symposium	Term 2 2025

Name of Unit Member (Author-Presenter)	Type	Title	Outlet	Term
Vincenzo Calabrese	Presentation at Conference	Extensibility governs the flow-induced alignment of polymers and rod-like colloids	Annual European Rheology Conference (AERC)	Term 2 2024
Fabian Hillebrand	Presentation at Conference	Flow of shear-banding viscoelastic fluids over long cavities	Annual European Rheology Conference 2024	Term 2 2024
Steffen Recktenwald	Presentation at Conference	Large Amplitude Oscillatory Extension (LAOE) of dilute polymer solutions	95th Annual Meeting of The Society of Rheology	Term 1 2024
Mark Sullivan	Presentation at Conference	Nanotechnology for Development of the Next Generation Low-Cost Stress Sensors	RAM	Term 1 2024
Vincenzo Calabrese	Presentation at Conference	How do polymers stretch in capillary-driven extensional flows?	95rd SOR Annual Meeting	Term 1 2024
Simon Haward	Presentation at Conference	Large Amplitude Oscillatory Extension of Polymer Solutions	British Society of Rheology Midwinter Meeting	Term 1 2024
Ricardo Arturo Lopez de la Cruz	Presentation at Conference	Drawing parallels: small-scale canopy elastic turbulence versus large-scale inertial turbulence	JSFM Annual Meeting 2024	Term 1 2024
Simon Haward	Presentation at Conference	Effects of polymer concentration and polydispersity on elastocapillary thinning of dilute solutions	95th Annual Meeting of The Society of Rheology	Term 1 2024
Steffen Recktenwald	Presentation at Conference	Large Amplitude Oscillatory Extension (LAOE) of dilute polymer solutions	Annual Meeting of the Japanese Society of Fluid Mechanics	Term 1 2024
Mohamed Abdelgawad	Presentation at Conference	The effect of fluid elasticity and plasticity on the flow within wavy channels	AERC, Leeds	Term 2 2024
Mark Sullivan	Presentation at Conference	Developing Synthetic Recognition Materials for Low-Cost Lab-on-a-Chip Diagnostics	Lab-on-a-chip, Microfluidics & Organ-on-a-Chip, Asia	Term 1 2024
Kohei Abe	Presentation at Conference	Coalescence of particle-coated oil droplets owing to evaporation of a continuous water phase	14th Asian Coating Workshop	Term 2 2024
Kohei Abe	Presentation at Conference	Solidification dynamics in drying colloidal suspensions measured by optical coherence tomography: effect of initial particle concentrations on formation kinetics of a solid film	22nd International Coating Science and Technology Symposium	Term 1 2024
Yuto Yokoyama	Presentation at Conference	High-Speed Stress Field Measurement In A Soft Substrate During Droplet Impact	21st International Symposium on Applications of Laser and Imaging Techniques to Fluid Mechanics	Term 3 2024
Yuto Yokoyama	Presentation at Conference	高速度偏光カメラを用いた三次元応力場の非定常計測手法とその適用例	第 52 回可視化情報シンポジウム	Term 3 2024
Yuto Yokoyama	Presentation at Conference	Relaxation time of rod-like particle alignment under shear or extensional flow: the effect of particle polydispersity	77th American Physical Society Division of Fluid Dynamics (APS-DFD) meeting	Term 1 2024

Name of Unit Member (Author-Presenter)	Type	Title	Outlet	Term
Ricardo Arturo Lopez de la Cruz	Presentation at Conference	Drawing parallels: small-scale canopy elastic turbulence versus large-scale inertial turbulence	2024 Annual Meeting of the Society of Rheology	Term 1 2024
Vincenzo Calabrese	Seminars	How do polymers stretch in capillary-driven extensional flows?	University of Naples Federico 2nd	Term 3 2024
Vincenzo Calabrese	Seminars	How do polymers stretch in capillary-driven extensional flows?	University of A Coruña	Term 3 2024
Simon Haward	Seminars	Large Amplitude Oscillatory Extension of Polymer Solutions. J Non-Newtonian Fluid Mechanics + J Rheology + Rheologica Acta	Joint Online Seminar Series	Term 1 2024
Simon Haward	Seminars	Exploring the Limits of Capillary-thinning Extensional Rheometry	Keshavarz group seminar, Duke University	Term 1 2024

Honors, Awards & Fellowships

2025-01-01 - Ongoing	Annual FLOW Lecturer, アニュアルフローレクチャラー, 2025, KTH
2022-04-01 - Ongoing	Excellence in Mentoring Award, エクセレンスインメンタリングアワード, 2022, OIST
2022-04-01 - Ongoing	The Society of Rheology Fellows, ソサエティーオブレオロジーフェロー, 2022, The Society of Rheology
2021-09-01 - Ongoing	APS Fellow, APS フェロー, 2021, American Physical Society
2021-04-01 - Ongoing	Fellow of the Royal Society of Chemistry, フェローオブロイヤルソサエティーオブケミストリー, 2021, Royal Society of Chemistry
2019-04-01 - Ongoing	Annual Bergveld Lecturer, アニュアル Bergveld レクチャラー, 2019, University of Twente
2008-04-01 - Ongoing	Best paper award, ベストペーパーアワード, 2008, Particle Technology Forum, AICHE meeting
2003-04-01 - Ongoing	Ralph E. Powe Junior Faculty Enhancement Award, Ralph E. Powe ジュニアファカルティーエンハンスメントアワード, 2003

Honors, Awards & Fellowships (only by unit members)

2024-10-13	Steffen Recktenwald, Best Postdoctoral Fellow Poster Award' (1st place) in the post-doctoral section , ベストポストドクトラルフェローポスターアワード, 2024, The Society of Rheology, 第 95 回ソサエティ　オブ　レオロジー学会、オースティン、アメリカ、10/13-17,2024

External Service

2024-01-01 - Ongoing	APS-DFD Member-at-Large, APS
2022-01-01	Editorial Board, Journal of Rheology
2020-04-01 - Ongoing	Associate Editor, Soft Matter
2020-01-01 - Ongoing	Editorial Advisory Board, ACS Biosensors
2019-01-01 - Ongoing	Editorial Advisory Board, Biomicrofluidics

2019-01-01 - Ongoing	Editorial Board, VIEW
2017-01-01 - Ongoing	Editorial Board, Physics of Fluids

Other Institutional Service

2025-05-01 - Ongoing	Provost, (University)
2025-05-01	Board of Councils, (University)

Outreach Activities (For Unit Members Only)

2025-02-01	Shen Unit, Science Festival, OIST
2024-10-09	Jiangming Wu, Program assistant for Yokohama Science High School Visit, OIST
2024-08-05	Jiangming Wu, Volunteer for OIST-KEIO International Research Summer Camp, OIST
2024-03-24	Jiangming Wu, Volunteer work for the visit of Keizai Doyukai, OIST

Workshops and Seminars (Organized and Hosted by Faculty/Units)

Speaker Name(s)	Title	Location	Date
Professor Nick Turner	Molecularly Imprinted Polymers for Biomedical Applications	OIST	2025-02-12
Prof. Matthieu Labousse	Dynamical elasto-capillary self-assembly	OIST	2024-12-09
Dr. Damir Juric	Immersed Boundary Numerical Simulation in Microfluidic Flows	OIST	2024-12-03
Emily Chen	Viscoelastic flow instabilities in porous media: insights from pore-scale flow fields	OIST	2024-09-10
Dr. Konstantinos Zinelis	Numerical Simulations of Viscoelastic Interfacial Flows: Jets, Filaments and Drop Impact	OIST	2024-09-03
Prof. Amos Danielli	Optical modulation biosensing for rapid and highly sensitive detection of biomarkers at low resource settings	OIST	2024-07-23
Prof. Emilio Satoshi Hara	Exploring the potential applications of cell membrane in biohybrid devices	OIST	2024-06-19
Prof. Lucas Goehring	Drying colloidal films, from a liquid dispersion to a rigid coating	OIST	2024-04-30
Prof. Zhihong Nie	Directional Bonding of Inorganic Nanoparticles Like Atoms	OIST	2024-04-04