

H.Burak Eral

CONTACT INFORMATION

Process & Energy Department
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RESEARCH INTERESTS

My research spans interdisciplinary fields: soft matter, advanced materials for intensified processes, hydrodynamics, crystallization and wetting physics. I intend to extend our current understanding of the physiochemical phenomena governing dynamics and phase behavior of soft matter systems. Building on this fundamental understanding, I develop soft materials capable of evolving processes and manufacturing techniques essential for maintaining our quality of life beyond the state of the art. Through careful, rational design of constituents and elaborate combination of external fields (in hydrodynamic, optical, magnetic and electric nature), I use bottom-up self-assembly with top-down processing for the design of novel tailored materials for fine chemicals, energy and biotechnology industry

POSITIONS AND EMPLOYMENT

Technical University of Delft, The Netherlands

Assistant Professor in Process & Energy department

Oct 2015 – present

I am a group leader focusing on developing soft matter and microfluidic inspired approaches for unveiling the underlying physical mechanisms such as crystallization and polymorphism. We are also working on fundamental hydrodynamic interactions to control the micro-particle trajectories and assembly of cell-like entities.

University of Utrecht, The Netherlands

Veni fellow in Van't Hoff Labs

Dec 2014 – Oct 2015

As a Veni fellow, I started a small research group within the Van't Hoff Labs focusing on controlling polymorphism using soft matter and microfluidic methods and fundamental hydrodynamic interactions.

Massachusetts Institute of Technology, USA

Postdoctoral Fellow in Chemical Engineering Department

April 2012 – Dec 2014

At MIT, I work on two research areas: (i) functional material synthesis via microfluidics (ii) quasi-two-dimensional hydrodynamic flows. (i) I am developing functional hydrogels for transforming crystallization, (a critical batch process in the pharmaceutical industry) into a continuous hence a low-cost and more efficient process. Moreover, I study hydrodynamic interactions between particles in microfluidic flows (ii). We have recently shown that through rational design of particle shape, trajectories of self-steering particles can be engineered in microfluidic flows eliminating costly external manipulations.

University of Twente, The Netherlands

Doctoral Dissertation in Physics of Complex Fluids Group

February 2007 – March 2012

- Thesis Title: Colloidal suspensions under external control defended in March 2011
- Advisors: Professor Frieder Mugele, Dr.Michel Duits, Dr.Dirk van den Ende

Throughout my PhD, I developed experimental methods to manipulate Soft Matter by altering boundary conditions and utilizing external fields. For this purpose, I developed approaches which can be summarized under three clusters (i) Confinement: I developed an apparatus capable of confining colloidal suspensions in controlled, well defined gaps integrated onto a confocal microscope for acquiring single particle level information. (ii) Microfluidics: developed a multilayer microfluidic systems to confine Soft Matter in well defined three dimensional geometries, (iii) Wetting: I addressed fundamental wetting questions concerning wetting morphologies of fibers and evaporation of colloidal suspensions by altering wetting boundary conditions via electrowetting. I have also worked towards commercialization/valorization of eMALDI. eMALDI transforms the popular analytical detection method MALDI-MS into a more sensitive, robust and faster method by solving a bottleneck. Our efforts lead to a startup company eMALDI.B.V (www.emaldi.eu).

University of California Santa Barbara, USA

Master of Chemical Engineering (Honors)

September 2003 – June 2005

At UCSB, I developed a Dynamic Nuclear Polarization (DNP) tool for signal enhancement in Nuclear Magnetic Resonance (NMR). I worked on designing a pneumatic system to simultaneously transfer and heat samples from Electro Spin Resonance (ESR) machine at -177°C where the DNP enhancement is achieved, to NMR where the detection is performed at room temperature.

Bogazici University, Istanbul, Turkey

Bachelors of Chemical Engineering (High Honors)

September 1999 – June 2003

PUBLICATIONS

(1). Mampallil, D., **Eral, H.B** A Review on Suppression and Utilization of the Coffee-Ring Effect Advances in Colloid and Interface Science (2018)

(2) Kacker, R., Dhingra, S., Irimia, D., Ghatkesar, M., Stankiewicz, A., Kramer, H.J.M., **Eral, H.B** Multi-Parameter Investigation of Laser Induced Nucleation of Supersaturated Aqueous KCl Solutions Crystal Growth & Design (2017).

(3) Rehor, I., van Vreeswijk, S., Vermonden, T., Hennink, W.E., Kegel, W.K., **Eral, H.B** Biodegradable Microparticles for Simultaneous Detection of Counterfeit and Deteriorated Edible Products, Small (2017) . *Highlighted in Advanced Science, TU Delft website, De Ingenieur, NPT, University of Utrecht website

(4) Brown, P., Sresht, V., **Eral, H.B**, Fiore, A., de la Fuente-Nez, C., OMahony, M., Mendes, G.P., Heller, W.T., Doyle, P.S., Blankschtein, D., Hatton, T.A. CO₂-Reactive Ionic Liquid Surfactants for the Control of Colloidal Morphology, Langmuir (2017).

(5) Kudina, O., **Eral, H.B**, Mugele, F. E-MALDI: Optimized conditions during electrowetting-enhanced drop drying for MALDI-MS, J. Mass Spectrom. (2017).

(6) **Eral, H.B**, Safai, E.R., Keshavarz, B., Kim, J.J., Doyle, P.S. Governing Principles of Alginate Microparticle Synthesis with Centrifugal Forces, Langmuir 32, 71987209 (2016).

(7) Kudina, O., **Eral, H.B**, Mugele, F. E-MALDI: An Electrowetting-Enhanced Drop Drying Method for MALDI Mass Spectrometry, Anal. Chem. 88, 46694675 (2016).

(8) Gupta, A., **Eral, H.B**, Alan Hatton, T. S. Doyle, P. Nanoemulsions: formation, properties and applications, Soft Matter 12, 28262841 (2016).

(9) Gupta, A., **Eral, H.B**, Alan Hatton, T. S. Doyle, P. Controlling and predicting droplet size of nanoemulsions: scaling relations with experimental validation, Soft Matter 12, 14521458 (2016).

(10) **H.B.Eral**, M.Omahony, B.Trout, A.Myerson, P.S.Doyle **Chemistry of Materials** 2014 26 (21), 6213-6220, Composite biocompatible hydrogels for controlling crystallization of water insoluble pharmaceuticals

(11) **H.B.Eral***, **V.Lopez-Mejias***, B.Trout, A.Myerson, P.S.Doyle **Crystal Growth & Design** 2014 14 (4), 2073-2082 "Towards control of nucleation and encapsulation with alginate hydrogels: A biocompatible vehicle for hydrophilic and hydrophobic drugs"

(12) **W.E.Upsal***, **H.B.Eral***, P.S. Doyle **Nature Communications**, 2013, (4), 2666 DOI : 10.1038/ncomms3666 "Engineering particle trajectories in microfluidic flows using particle shape"

(13) H.Z.An, E.Safai, **H.B.Eral**, P.S.Doyle **Lab-on-Chip**, 2013, 13 (24), 4765-4774 "Synthesis of biomimetic oxygen-carrying compartmentalized microparticles using flow lithography"

(14) **H.B.Eral**, D.Mannetje, J.M.Oh, Invited review on **Colloid & Polymer Science**, 2013, 219 (2), 247-260 "Contact angle hysteresis: A review of fundamentals and applications",

(15) D.Mampallil, **H.B.Eral**, D.van den Ende, F.Mugele **Physical Review E** 2013, 88, 053015 "Electrowetting-driven oscillating drops sandwiched between two substrates"

(37), 1330013306 "Buoyant droplets on functional fibers"

(17) **H.B.Eral**, F.Mugele, M.Duits **Langmuir** 2011, 27, 1229712303, "Colloidal dynamics near a particle-covered surface"

(18) D.Mampallil, **H.B.Eral**, D.van den Ende, F.Mugele **Soft Matter** 2012, 8, 10614- 10617 "Control of evaporating complex fluids through electrowetting"

(19) **H.B.Eral**, G.Manukyan, J.M.Oh **Langmuir**, 2011, 27 (9), 53405346 "Wetting of a drop on a sphere",

(20) **H.B.Eral**, D.Mampallil, F.Mugele **Soft Matter**, 2011, 7, 4954-4958 "Suppressing the coffee stain effect: how to control colloidal self-assembly in evaporating drops using electrowetting",

*Highlighted in NTvN, Arago Focus, Physics World and Soft Matter as Top 10 downloaded paper

(21) **H.B.Eral**, R.Ruiter, J.Ruiter, J.M.Oh, C.Semprebon, M.Brinkmann, F.Mugele **Soft Matter**, 2011, 7 (11), 5138 5143 "Reversible morphological transitions of a drop on a fiber"

*Highlighted as cover of Soft Matter, Hot article in Soft Matter, in Physics Today and in ARAGO Focus.

(22) **A.Agiral***, **H.B.Eral***, D.van den Ende, H.Gardeniers **IEEE Transactions on Electron Devices**, 2011, 58 (10), 3475-3486 "Charge injection from carbon nanofibers into hexane under ambient conditions"

(24) **H.B.Eral**, M.Duits, J.M.Oh, D.van den Ende, F.Mugele **Langmuir**, 2010, 26 (22), 16722 16729 "Anisotropic and hindered diffusion of colloidal particles in a cylinder"

(25) **H.B.Eral**, D.van den Ende, F.Mugele, M.Duits, **Physical Review E**, 2009, 16 (4), 319-322, "Influence of rough and smooth walls on dynamics of concentrated colloidal suspensions in confinement"

* indicate equal contribution

PATENTS

H.B.Eral, V.Lopez-Mejias, A.Myerson, B.Trout, P.Doyle "Biocompatible polymeric hydrogels for controlling nucleation from solution and loading of hydrophobic and hydrophilic pharmaceuticals" pending US patent, 2013

H.B.Eral, D.A.Mampallil, F.Mugele "A method for treating a liquid drop", World Patent *WO*2011 – 145929 and European patent *PCT – NL*2011 – 050328, 2011.

POPULAR SCIENCE "Soft matter inspired novel crystallization reactors " ,TG Magazine, 2017
ARTICLES

"Say goodbye to coffee stains" Physics World,25, (4),33-37, 2012

"Weg met die koffievlekken" NTvN 78, 54-58, 2011

"Tired of coffee stains ? " Arago Focus, 2011

"Fundamental wetting physics for cleaning oil spills" Arago Focus online 2011

INVITED TALKS

"eMALDI: Next generation MALDI-MS detection through Electrowetting" Tecan meeting, 2012, Boston, USA

"Wetting phenomenon in Soft Matter" 19. Istanbul Statistical Physics days, 2012, Istanbul, Turkey

"From fundamental wetting principles to oil spill cleaning" Physics of Fluids colloquium, 2012, Liege, Belgium

"Soft Matter under the external control " Sabanci University, 2011,Istanbul, Turkey

" Soft Matter under the external control " Koc University, 2011, Istanbul, Turkey

"Manipulation of soft matter through wetting phenomena" STR6 colloquium 2011 Dusseldorf

"Soft Matter under external control" UIUC, S.Granick group, 2011. Urbana, IL, USA

"Soft Matter under the external control" MIT, P.Doyle Group, 2011, Boston, USA

"Drop on a fiber: From a classic capillarity problem to advanced materials ", Bogazici University, 2011, Istanbul, Turkey

"Confinement effects on colloidal suspension: Microfluidic Methods for confinement", STR6 colloquium, 2010, Mainz, Germany

"Manipulation of Soft Matter using Microfluidics, Confinement and Electrowetting", Christ College, D.Aarts group, 2010, Oxford, UK

"Electrowetting functionalized filters for Oil-Water separation", Norit Membrane Technologies, 2010, Enschede, The Netherlands

"Dynamics of concentrated colloidal suspensions in confinement", Soft Matter colloquium, 2009, Utrecht, The Netherlands

ORAL
PRESENTATIONS IN
CONFERENCES

"Manipulation of Wetting phenomenon in Soft Matter" Squishy Physics Meeting, 2012, Harvard University, Cambridge, USA

"Soft Matter under the external control", ACS colloids, 2012, Baltimore, USA

"Particle tracking in temperature responsive organogel", SOR, 2012, Pasadena, CA, USA

"Lessons from nature on how to clean oil spills : Electrowetting functionalized fibers", Nanomaterials for Energy strategic meeting, 2011, Enschede, The Netherlands

"Particle at oil-water interfaces" BP Rock on a chip meeting, 2011, Copenhagen, Denmark

"Dynamic suppression of coffee stains", APS-DFD, 2011, Baltimore, USA

"Wetting Morphology of a drop on a fiber: Barrel to Clam-Shell and back", APS-DFD, 2011, Baltimore, USA

"Dynamic suppression of coffee stain effect", Burgersdag, 2011, TU Delft, The Netherlands

"Electrowetting functionalized fibers: morphologies of a drop on a fiber", Rock on a chip BP annual meeting, 2010, Enschede, The Netherlands

"Dynamics of concentrated colloidal suspensions in confinement", FOM days, 2009, Veldhoven, The Netherlands

"Confinement effects of Hard Sphere like colloidal suspensions", Liquids and Interphases, Lunteren, The Netherlands.

HONORS AND
AWARDS

Cohesion grant, TU DELFT, 2017 (180,000Euro) Veni fellow, NWO, 2015, (250,000Euro)

Valorization grant phase *I&II* from Dutch Ministry of Science (STW) 2012&2013 (250,000 Euro)

Startup subsidy from Twente region (40,000 Euro)

MIT-MISTI international collaboration grant 2013 (25,000\$)

Oak Ridge National labs travel and beam time for neutron scattering 2013 (5,000\$)

Best presentation award, Burgers center for Fluid dynamics and Capillarity course, The Netherlands 2011

Poster Award, National Colloid and Soft Condensed Matter days, Lunteren, The Netherlands 2007

PROFESSIONAL
EXPERIENCE

Journal reviewer for Nature Communications, Scientific Reports, Soft Matter, Langmuir, Physical Review E, Colloid & Polymer Science, Journal of Adhesion Science.

COMMUNITY
ENGAGEMENT &
OUTREACH
ACTIVITIES

Instructor for MIT ESP 2013 "S7264: Experimental and Computational Methods in Squishy Materials" for high school students.

Instructor for UCSB EPSEM mentoring program for underprivileged K12 students.

Instructor for University of Twente "Open dag" for high school students.

Popular science writer for Physics World, NTvN, Arago Focus.

REFERENCES

Professor Frieder Mugele

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Bogazici University

Istanbul, Turkey

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