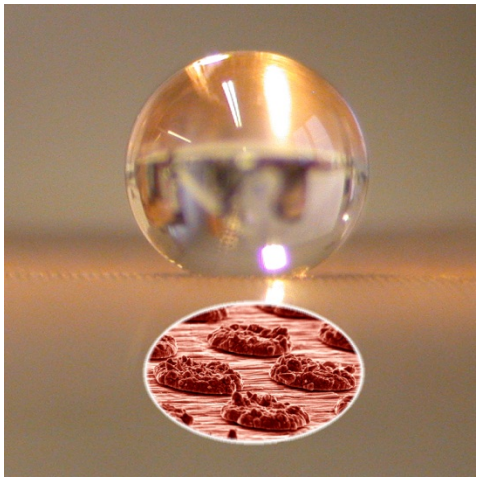
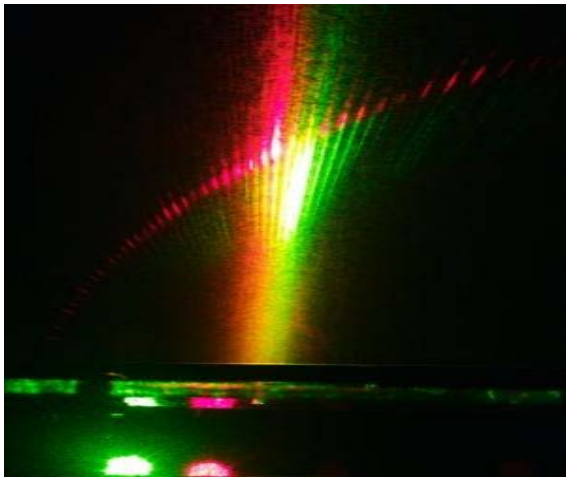
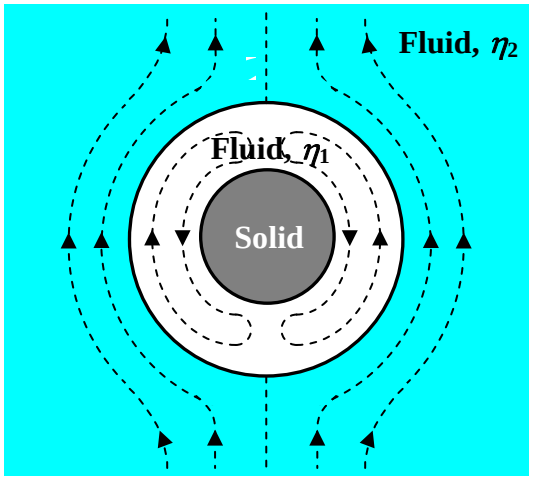






Research Team name: Solid-Liquid Interfacial Interactions
Presenter name: Professor Glen McHale
glen.mchale@northumbria.ac.uk
http://www.naturesraincoats.com/

Team Presentation – Annual Workshop, COST Action MP1106
Dublin, September, 2012

Research Team Name: Solid-Liquid Interfacial Interactions

Number of team members: (2+2) Academics, (3+2) PDRAs, 3+ PhDs

Brief description of team: Applied Physics and Materials
Northumbria (Newcastle) and Nottingham Trent

Team:
Professor Glen McHale — Physicist: Theory, wetting/spreading, electrowetting, superhydrophobicity, SAWs
Dr. Michael Newton — Experimental Physicist: acoustic waves, instrumentation, microfabrication, MRI

Linked Academics:
Professor Carl Brown: Displays, liquid crystals, optofluidics, photonics, electrowetting
Dr. Fouzia Ouali: Photonics, optoelectronics and microfabrication

5 Linked PDRFs: Dr. Christophe Trabi, Dr. Shaun Atherton, Dr. Christopher Hamlett, Dr. Costos Tsakonas, Dr. Ian Sage

Linked PhDs: Mr Haadi Javed, Mr Jo Brennan, Mr Nic Geraldi
Mr M. Shamim + others

Technicians: Shared: Assigned within departments and not within research groups

Masters and Undergraduates Students: Changes all the time

Research interests related to MP1106:

WG1 Fundamentals (and Possibly WG2 Materials)

- Chemical and physical design of surfaces
- Superhydrophobic and superhydrophilic surfaces
- Wicking, hemiwicking and controlled wetting surfaces
- Electrowetting (and dielectrowetting)
- Drag reduction and slip
- Optofluidics

WG3 Diagnostics

- Lithography, deposition and etching of materials to create patterned and structured surfaces
- Contact angle measurements
- High speed video and other methods (MRI, SEM, TEM, microscopy) to characterize surfaces and interfaces
- Microfabrication and microfluidics

Basic facilities, equipment, devices etc:

Fabrication and Surface Characterisation (Northumbria/NTU)

- Thin film fabrication and lithographic lab with a Süss Microtech MJB4 mask aligner and associated facilities (spin coater, assorted metal deposition, wafer dicing, etc).
- Rapid prototyping suite, laser cutting and a 3D printer for constructing test cells, sample holders, etc, and CAD and PCB facilities for mask design
- JEOL scanning electron microscope with x-ray analytical facilities
- Optical and contact surface profilometry, Mach-Zehnder interferometry

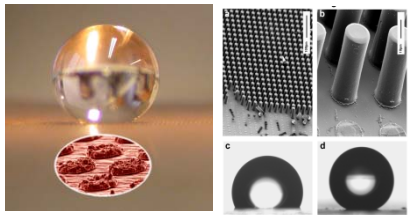
Contact Angles, High Speed Imaging and Electrical (Northumbria/NTU)

- Krüss DSA10, 3 high speed cameras, USB cameras, LC Impedance measurements
- Assorted network analyzers, digital oscilloscopes, TREK high V amplifier, signal sources
- Quartz Crystal Microbalance (QCM) and Surface Acoustic Wave (SAW) instrumentation

Flow Chamber and Materials MRI (at NTU)

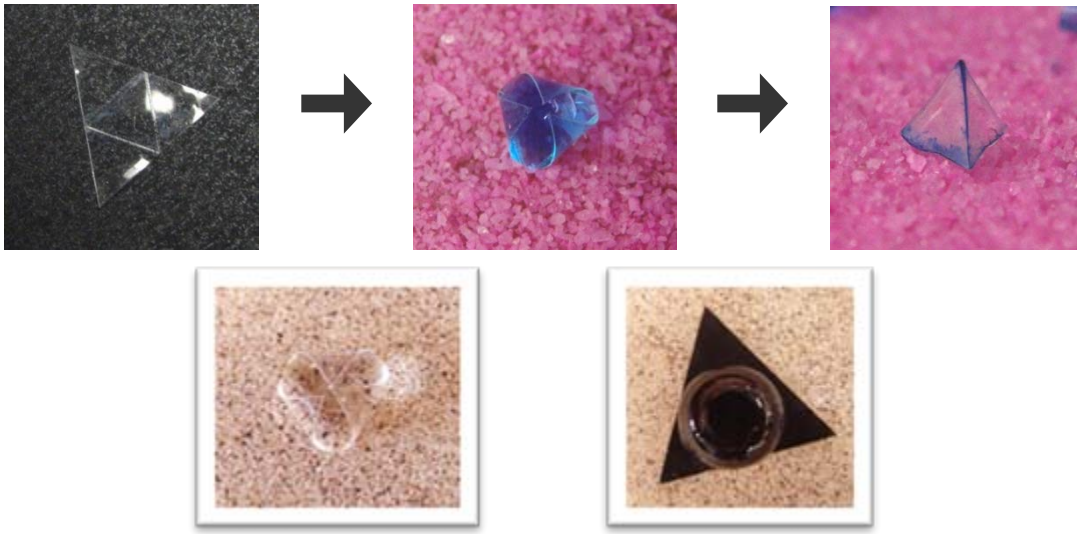
- Large volume flow chamber with Dantec Laser Doppler Anemometer (wake profiles)
- 2.35T Bruker Biospec MRI Scanner, 0.5T Halbach MRI, NMR MOUSE (unilateral)
- Capabilities to create cheap distributable MRI sensors

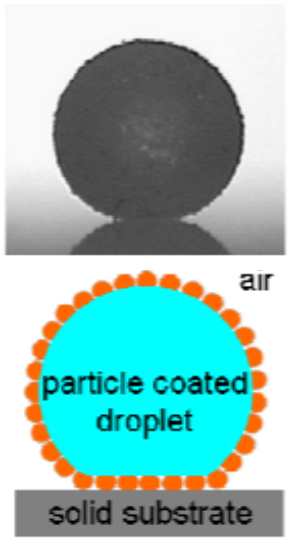
Projects



#1 project :

Title:	Exploiting the Solid-Liquid Interface
Duration:	2007-2013
Funding organization:	UK EPSRC Grant EP/E063489/1
People involved and their function:	Multiple projects on surface wetting
Facilities/equipment:	People funding
Most interesting results:	





1. N.J. Shirtcliffe, G. McHale and M.I. Newton, *Wet adhesion and adhesive locomotion on anti-adhesive non-wetting surfaces*, PLoS ONE **7** (2012) e36983.
2. G. McHale, et al, *Capillary origami: superhydrophobic ribbon surfaces and liquid marbles*, Beilstein J. Nanotechnol. **2** (2011) 145–151.
3. N.J. Shirtcliffe, et al., *Learning from superhydrophobic plants: The use of hydrophilic areas on superhydrophobic surfaces for droplet control*, Langmuir **25** (2009) 14121

Projects

#2 project :

Title: Engineering of surfaces for drag reduction in water with validation using computational and experimental methods

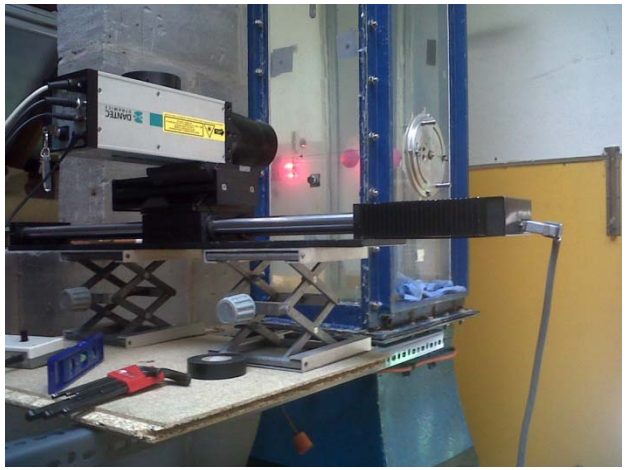
Duration: 2009-2013, 2011-2014

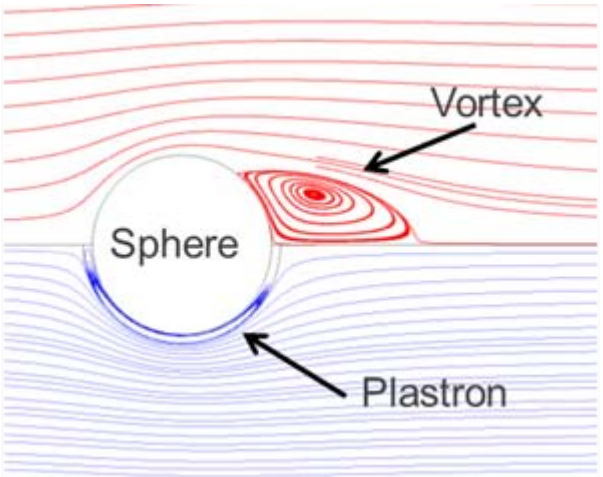
Funding organization: UK EPSRC Grant EP/G057265/1 + NTU PhD

People involved and their function: 1 PDRF Nottingham, 1 PDRF+1 PhD Southampton

Facilities/equipment: Flow chamber with LDA

Most interesting results:



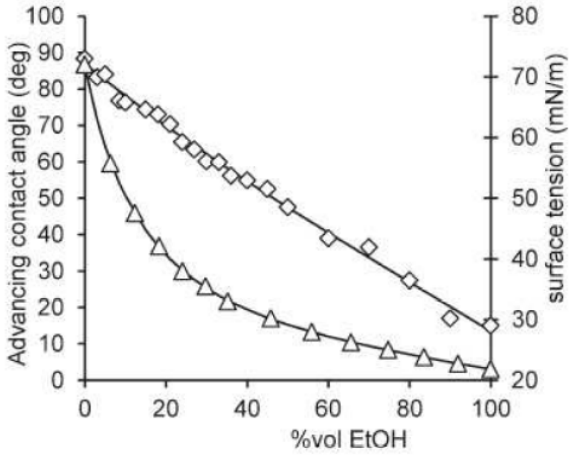


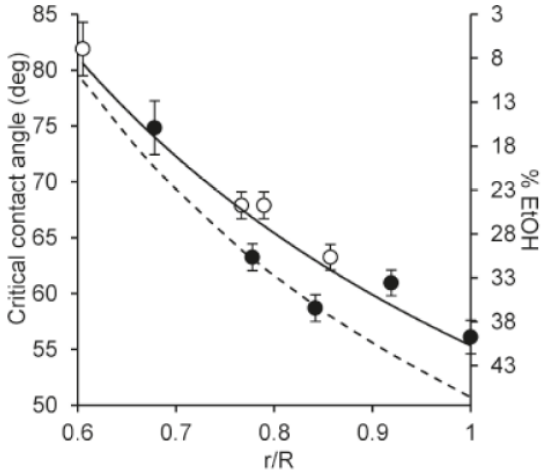
1. G. McHale, M.R. Flynn and M.I. Newton, *Plastron induced drag reduction and increased slip on a superhydrophobic sphere*, Soft Matter **7** (2011) 10100-10107.
2. G. McHale, et al, *Terminal velocity and drag reduction measurements on superhydrophobic spheres*, Appl. Phys. Lett. **94** (2009) art. 064104.
3. N. J. Shirtcliffe, et al., *Superhydrophobic copper tubes with possible flow enhancement and drag reduction*, ACS Appl. Mater. Interfaces **1** (2009) 1316-1323.

Projects

#3 project :

Title:	Particle based superhydrophobic surfaces: Lab models-to-field sample behaviour
Duration:	2009-2013
Funding organization:	UK EPSRC Grant EP/H000704/1
People involved and their function:	1 PDRF +1 PhD Swansea
Facilities/equipment:	High speed camera
Most interesting results:	





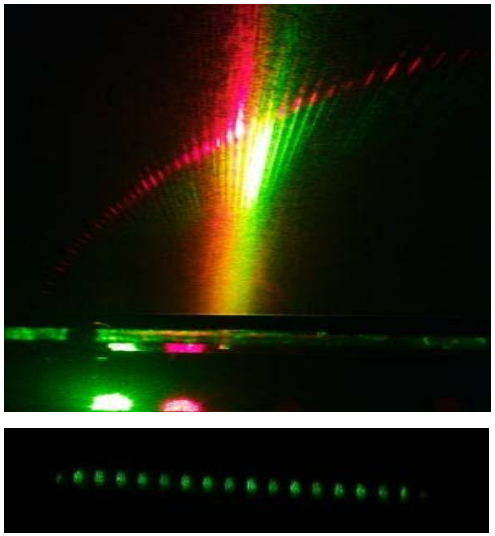
1. C.A.E. Hamlett, et al, *Effect of particle size on droplet infiltration into a model water repellent soil*, Environ. Sci. Technol. **45** (2011) 9666-9670.
2. J. Bachmann & G. McHale, *Superhydrophobic surfaces:A model approach to predict contact angle and surface energy of soil particles*, Eur. J. Soil Sci. **60** (2009) 420-430.

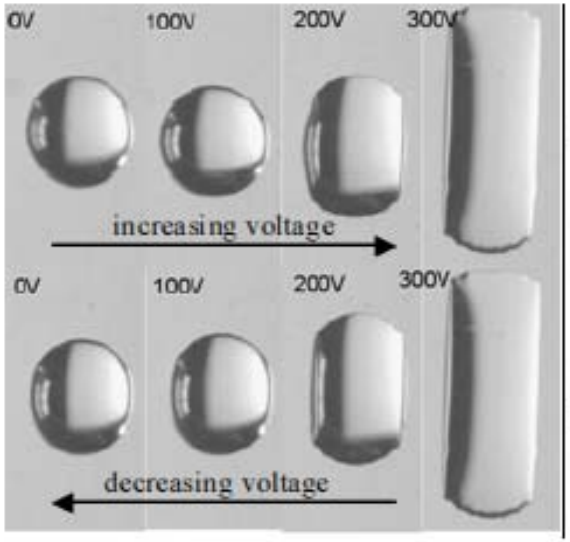
Projects

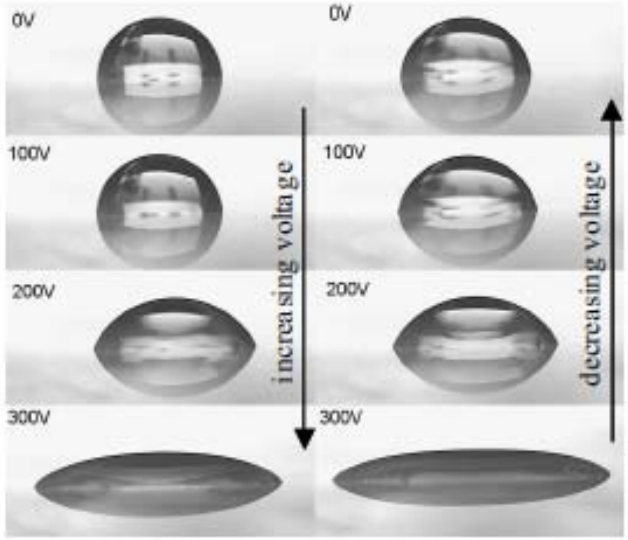
#4 project :

Title:	Electrowetting and Dielectrowetting
Duration:	2009-2013
Funding organization:	UK EPSRC EP/E063489/1
People involved and their function:	2 PDRF +1 PhD
Facilities/equipment:	Mach-Zehnder, TREK, etc

Most interesting results:





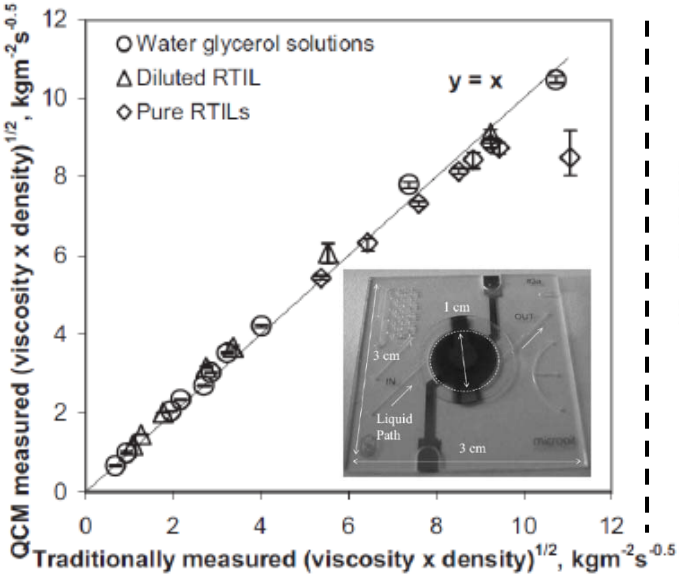


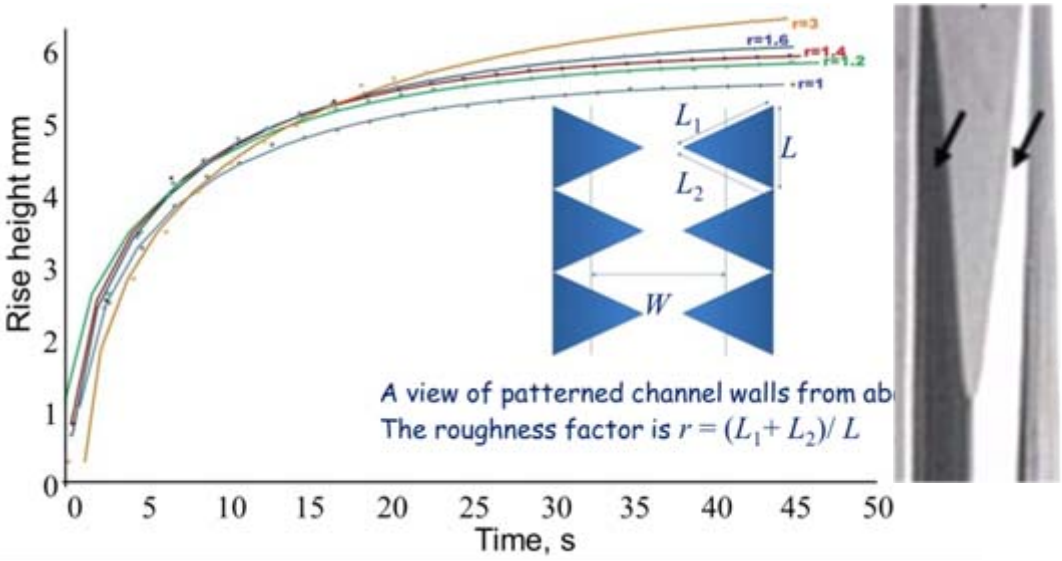
1. G. McHale, C.V. Brown, M.I. Newton, G.G. Wells and N. Sampara, *Dielectrowetting driven spreading of droplets*, Phys. Rev. Lett. **107** (2011) art. 186101.
2. C.V. Brown, G. Wells, M.I. Newton and G. McHale, *Voltage-programmable liquid optical interface*, Nature Photonics **3** (2009) 403-405

Projects

#5 project :

Title: Microfluidics and Capillary Rise/Imbibition
Duration: 2009-2013, 2012-2014
Funding organization: NTU and EPSRC Grants EP/D03826X/1, EP/E063489/1
People involved and their function: 1 PDRF + 1 PhD
Facilities/equipment: Lithography, high speed camera, various microfluidics
Most interesting results:





1. F. F. Ouali, et al, *Determination of the physical properties of room temperature ionic liquids using a Love wave device*, Anal. Chem. **83** (17) (2011) 6717–6721.
2. D. Kuvshinov, et al, *Thermal conductivity measurement of liquids in a microfluidic device*, Microfluidics and Nanofluidics, **10** (1) (2011) 123-132.
3. N. Doy, et al, *Small volume lab-on-a-chip measurements incorporating the quartz crystal microbalance of RTILs*, Biomicrofluidics, **4** (1) (2010) art. 014107.

Topics for Research Proposal

#1 Topic

Title: Liquid marbles as miniature chemical reactors and soft droplet-on-a-chip microfluidics

Promotion images & text:

"Containerized transport and reactions using hydrophobic encapsulated particles"

1. G. McHale and M.I. Newton, *Liquid Marbles: Principles and Applications*, Soft Matter **7** (12) (2011) 5473-5481.

Duration (*if estimated*): 3 years +

Expertise required: Chemistry, Biology

Facilities/equipment required: TBD

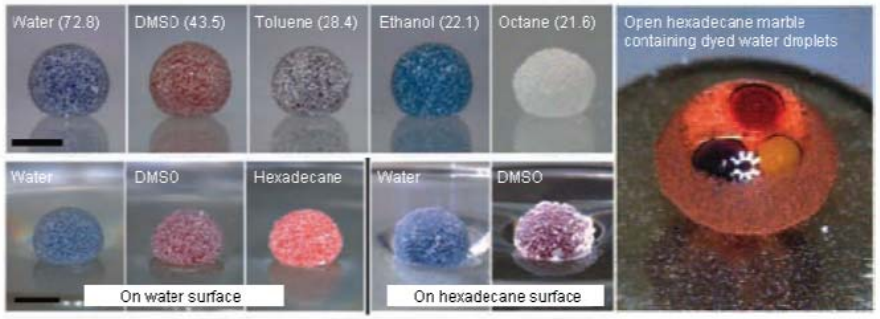
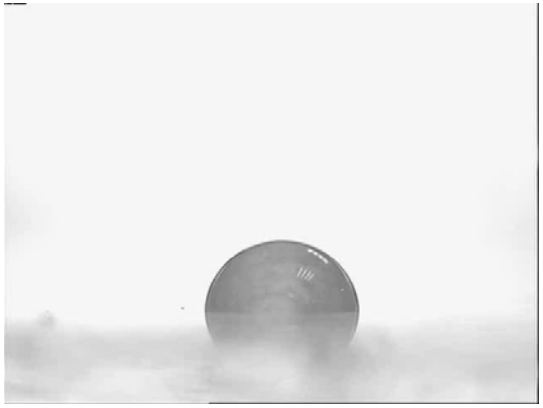


Figure 7 Encapsulation of low surface tension liquids and use as miniature reactors. Reprinted with permission from ref. 19. Copyright 2010 Wiley-VCH Verlag GmbH & Co. KGaA.

Topics for Research Proposal

#2 Topic

Title: Dielectrowetting - Superspreading without surfactants



Promotion images & text:

"Use of a voltage to control how far and how fast a dielectric liquid can be spread."

1. G. McHale, et al., *Dielectrowetting driven spreading of droplets*, Phys. Rev. Lett. **107** (18) (2011) art. 186101.
2. G. McHale, et al. *Voltage induced spreading and super-spreading of liquids*, Submitted (2012).

Duration: 3+ years

Expertise required: Electrowetting, surfactants

Facilities/equipment required: TBD

Thank you for your attention