**Masters Project:**

**Exploring the fundamental mechanism of a new phenomenon: Electro-dewetting.**

**Overview**

Controlling the properties of solid-liquid interfaces is crucial to a wide range of applications including printing, coating, microfluidics, lab-on-a-chip, electrocatalysis, and energy harvesting. There is great desire to control drops on surfaces using stimuli such as light, temperature, and in particular, **electric fields**. Very recently, a novel kind of actuation has been developed, **electro-dewetting** (EDeW)1. As the name suggests, a voltage applied on an EDeW drop causes it to “dewet” (or become rounder on) the surface, in direct contrast to well-known classical electrowetting (EWOD) where an applied voltage causes the drop to “wet” (or become flatter). EDeW relies on an entirely different mechanism to EWOD. It is believed that ionic surfactant added to the drop is pulled to the interface by an imposed electric field, hydrophobizing the interface and causing the drop to retract. EDeW is more reversible, more robust, and actuated by lower voltages than EWOD. However, the fundamental mechanisms behind the EDeW phenomenon are not yet understood, leaving an exciting open question for study.

![Diagram

Description automatically generated]()

**Research Objective**

The Physics of Complex Fluids group has been developing expertise in classical electrowetting for over 20 years, which makes this the perfect place to examine this new EDeW phenomenon. Already, preliminary experiments have been done to examine the residual surfactant layer left behind an EDeW drop to begin to explore the fundamental de-wetting mechanism2. Determining the characteristics of this layer could inform us about the fundamental mechanisms at play. Your primary research objective would be to fully map the thickness of these residual surfactant layers using an extremely powerful optical technique, **ellipsometry**. You will explore the parameter space (electric field strength, type of ionic surfactant, local humidity, etc.) and see if you can identify the best conditions for de-wetting as well as what the most important controlling variables are. Depending on your interest and experience, you may choose to write some analysis code for ellipsometry images (if you like to code), to improve the physical setup for electro-dewetting experiments (if you are inclined towards engineering), or to play with surfaces coatings for enhancing electrodewetting (if you enjoy chemistry).

**Learning Objective**

In addition to the standard learning objectives for a bachelor’s project (research planning, academic writing, data presenting, how to work in a lab environment, etc.), you will:

* Learn the fundamentals of capillarity, wetting, surfactants, and classic electrowetting
* Have basic chemical-lab training (preparing solutions, coating surfaces, etc.)
* Learn how to perform ellipsometry and analyze the results
* Learn to use a home-built electro-dewetting setup
* Depending on your interest, you may write analysis code in Python or Matlab, improve the setup, or do some surface chemistry

**Contact Information**

* Daily Supervision: Dr. Amy Stetten ([a.z.stetten@utwente.nl](mailto:a.z.stetten@utwente.nl))
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**Literature**

1. Li, J., Ha, N. S., Liu, T. ‘Leo,’ Dam, R. M. van & Kim, C.-J. ‘CJ.’ Ionic-surfactant-mediated electro-dewetting for digital microfluidics. *Nature* **572**, 507–510 (2019).
2. Bas ter Beest Masters Thesis