SYDW 1: Dynamical wetting of flexible, adaptive and switchable surfaces (SYDW)

Time: Thursday 15:00–17:45 Location: HSZ 02

Invited Talk SYDW 1.1 Thu 15:00 HSZ 02
Statics and Dynamics of Soft Wetting — •Bruno Andreotti — LPENS, 24 rue Lhomond, Paris

The laws of wetting are well-known for drops on rigid surfaces, but these change dramatically when the substrate is soft and deformable. The combination of wetting and the intricacies of soft polymeric interfaces has provided many rich examples of fluid-structure interaction, both in terms of phenomenology as well as from the fundamental perspective. In this colloquium, I will discuss experimental and theoretical progress on the statics and dynamics of soft wetting. In this context, I will critically revisit the foundations of capillarity, such as the nature of solid surface tension, the microscopic mechanics near the contact line, and the dissipative mechanisms that lead to unexpected spreading dynamics.

Invited Talk SYDW 1.2 Thu 15:30 HSZ 02
Modelling imbibition, dynamic wetting and evaporation on structured surfaces and porous coatings — •Tatiana Gambaryan-Roisman and Noemi Ghillani — TU Darmstadt, FG Technische Thermodynamik, Alarich-Weiss-Str. 10

Wetting of structured surfaces and surfaces with porous coatings, for example, nanofiber mats, is relevant for a wide variety of technical applications, such as printing technologies, superhydrophobic material applications and heat transfer enhancement technologies. Imbibition and evaporation of liquids on such surfaces are responsible for significant improvement of cooling efficiency during drop impact cooling and flow boiling. Up to now, no reliable model exists which is able to predict the kinetics of imbibition coupled with forced wetting/dewetting and evaporation on surfaces with porous coatings and surfaces with topography. In this work we consider one of mechanisms of imbibition on structured/porous substrates. This is the capillary pressure-driven flow in a groove or in a corner formed between a flat substrate and a fiber attached to it (representative of the first layer of a fiber mat). In this work theoretical/numerical model of simultaneous imbibition and evaporation is developed, in which viscosity, surface tension, gravity and forced wetting/dewetting are taken into account. The results are compared with available experimental data.

Invited Talk SYDW 1.3 Thu 16:00 HSZ 02
Droplets on shaped liquid and electrically switchable surfaces — •Glen McHale — Smart Materials and Surfaces Laboratory, Northumbria University, Newcastle upon Tyne, NE1 8ST, UK

The dynamic wetting of a surface by a droplet depends on the relaxation from an initial non-equilibrium to a final equilibrium state and the rate of dissipation during that relaxation. Here I will outline key work of our group and collaborators in studying two aspects of this process by reducing friction using lubricated surfaces and controlling droplet states using electric fields. Initially, I will explain how sessile droplets wet composite solid-liquid surfaces. I will then show how two length scales combined with gradient structures can be used to generate low friction bidirectional motion towards the more wettable solid or liquid surface. In the case of conformal lubricant coatings, I will argue the surface contacted by a droplet can be viewed as a low friction shaped liquid surface. I will then consider how non-uniform electric fields can be used to control the extent of wetting of a solid or lubricated surface by a droplet. Finally, I will show examples of using non-uniform electric fields as an effective and versatile tool for controlling wetting states and studying the dynamics of dewetting.

15 min. break

Invited Talk SYDW 1.4 Thu 16:45 HSZ 02
Liquid-liquid Dewetting: From Spinodal Breakup to Dewetting Morphologies and Rates — •Ralf Seemann[1], Stefan Bommer[1], Roghayeh Shiri[1], Sebastian Jachalski[2], Dirk Peschka[2], and Barbara Wagner[2] — [1]Saarland University, D-66123 Saarbücken — [2]Weierstrass Institute, D-10117 Berlin

The spinodal dewetting of liquid polystyrene (PS) from liquid polymethylmethacrylate (PMMA) is explored. Both polymers can be considered as Newtonian liquids with equal viscosities at dewetting temperatures. Provided the thickness of the liquid PMMA substrate is sufficiently large, the observed spinodal pattern is independent from PMMA film thickness. Because of the smaller interfacial tension of the buried interface compared to the PS-air interface and the large mobility, a very short spinodal wavelength develops with a larger amplitude of the buried interface than that of the free PS-air interface. The spinodal pattern of PMMA-PS and PS-air interface are anti-correlation and the wavelength is in quantitative agreement with theoretical predictions from thin film models. For a later dewetting stage, when dewetting rims have formed with sizes in the range of the PMMA film thickness, characteristic profiles of both the PMMA-PS and the PS-air interface develop, which depend on PMMA/PS thickness ratio. The dewetting rates, however, do not obey any well-defined scaling behavior and are close to linear. Based on the agreement of experimental results with theoretical predictions, we use the numerical simulations to predict local flow fields and the energy dissipation that otherwise would be inaccessible to experiments.

Invited Talk SYDW 1.5 Thu 17:15 HSZ 02
Droplet durotaxis and engulfment on yielding viscoelastic gels — •Anne Juel — Department of Physics & Astronomy, University of Manchester, Oxford Road, Manchester M13 9PL, UK

Durotaxis refers to the spontaneous motion of objects along stiffness gradients of the supporting substrate. For example, individual cells have the ability to detect substrate stiffness and usually migrate up rigidity gradients. In contrast, droplet durotaxis due to elasto-capillary interaction with soft substrates, leads to droplet migration down rigidity gradients towards the softer regions of the substrate. We perform experiments in which we explore droplet durotaxis in the limit of very soft PDMS substrates, where the cross-linked matrix of the gel may yield under the capillary stresses exerted by the sessile droplet. When we position an individual droplet on such a gel layer with a constant depth gradient, we find that the droplet moves towards the softest parts of the gel layer while also sinking into the gel and that droplet durotaxis is much faster when engulfment is associated with the motion. We explore the role of elastic forces in this process by comparing durotaxis on viscoelastic gels with engulfment into substrates of highly viscous Newtonian fluids.