CPP 26: Focus: Wetting on smooth and rough surfaces: From spreading to superhydrophobicity II

Wetting determines the morphology and dynamics of a liquid on a surface. In particular for rough, structured, or deformable surfaces the dynamic contact angles are poorly understood. Progress in experimental and numerical techniques permit time resolved three-dimensional investigations of wetting, providing new insight into the interplay between the contact angle, hysteresis, and pinning.
Organizers: Hans-Jürgen Butt (Mainz), Stephan Herminghaus (Göttingen), Doris Vollmer (Mainz)

Time: Wednesday 15:00–16:30 Location: H34

Invited Talk CPP 26.1 Wed 15:00 H34
Leidenfrost Dynamics — •David Quéré — ESPCI & Ecole polytechnique, Paris

We discuss the Leidenfrost phenomenon, and particularly focus on its dynamical aspects: how can liquids levitate on a hot solid? what are their particular shape and evolution? what is the friction of these liquid hovercrafts when they move? how do they behave on an irregular solid? is it possible to create a Leidenfrost situation without heat? We'll see that the absence of contact between a substrate and a liquid deeply modifies the usual laws of wetting.

CPP 26.2 Wed 15:30 H34
Directed motion of droplets on asymmetrically structured vibrating substrates: a Molecular Dynamics study — •Nikita Tretyakov and Marcus Müller — University of Göttingen

We study a transport of coarse-grained polymer droplets on asymmetrically structured (sawtooth shaped) and vibrating substrates by means of Molecular Dynamics. The temperature of the system is controlled by the DPD thermostat. Due to a continuous supply of power by substrate vibrations and the asymmetry of its topography, the droplets are driven in a preferred direction. This directed motion is investigated as a function of the size of the droplets, linear dimension of the substrate corrugation and the period of substrate vibrations. To this end, our main concern consists in resolving two questions: (i) what is the driving mechanism and (ii) what is the character of the flow inside the droplet?

A typical mechanism of driving is the one provided by droplet's contact lines, as the responses of the advancing and receding contact lines on the vibrating asymmetric substrate are not identical. We, moreover, find a range of vibration periods that lead to an additional driving by the contact area of the substrate between the contact lines.

For the character of the droplet motion there are, in general, three possibilities: sliding, rotating and a combination of both. All of them dissipate the input power by different means. We find that for most of the parameters the droplets are sliding, but the linear size of the substrate corrugation may give a rise to an additional rotation.

CPP 26.3 Wed 15:45 H34
Trapping and release of drops by electrically tunable wetting defects — Dieter 't Mannetje[1], Rudy Lagraauw[1], Simon Otten[1], Arun Banpurkar[1,2], Arjen Pit[1], Dirk van den Ende[1], and •Frieder Mugele[1] — [1]University of Twente, Physics of Complex Fluids, MESA+ institute for Nanotechnology, Enschede, The Netherlands — [2]University of Pune, Department of Physics, Pune, India

Drops driven across heterogeneous by gravity, viscous drag, and air flow can get stuck at pinning sites that are sufficiently strong compared to the external driving force. Using defects of continuously variable strength generated by electrowetting we study the critical conditions required to pin and depin drops of sliding down an inclined plane. We show that the strength of the electrical defects scales with the square of the applied voltage and with the radius of the drop. A generalized model incorporating the variable strength of the defect, viscous dissipation, and inertia of the sliding drop provides a general pinning criterion in excellent agreement with the experiments. We demonstrate the potential of electrically tunable defects as tools to manipulate and guide drops on inclined planes and in microfluidic devices.

CPP 26.4 Wed 16:00 H34
Wetting of non regular rough 3D surfaces — •Ciro Semprebon, Stephan Herminghaus, and Martin Brinkmann — MPI-DS, Göttingen, Germany

Modelling wetting of disordered rough surfaces is a challenging problem as the liquid interface can adopt a large number of different topologies in mechanical equilibrium. A recent study of regular surface topographies demonstrates that topological changes of the interface are important to understand the variety of emerging advancing and receding contact angles [1]. Here, we present a method to compute interfacial equilibria on arbitrary substrate topographies while allowing for varying interface topology. In this method the material contact angle can be controlled via a short ranged interface potential. To demonstrate its applicability, we studied drying of a rough substrate while decreasing the Laplace pressure of the wetting film. The results are compared to drying during a decrease of the total liquid volume or an increasing material contact angle at fixed Laplace pressure.

CPP 26.5 Wed 16:15 H34
Understanding the behaviour of super-cooled liquid on nanostructured surfaces: A molecular dynamics study — Jayant Singh[1,2] and •Florian Müller-Plathe[1] — [1]Technische Universität Darmstadt, Theoretical Physical Chemistry, Petersenstr. 22, 64287 Darmstadt — [2]Department of Chemical Engineering, Indian Institute of Technology Kanpur, Kanpur, India -208016, India

Understand the role of roughness of the surface in suppressing the ice formation is of critical importance in the design of ice-free nanostructured surfaces. While recent work has provided some insight to the design of superhydrophobic surfaces for deicing applications, yet it is not clear that having roughness leading to hydrophobicity itself is good enough for the smart design of ice-free nanostructure surface.

In this work, using extensive molecular dynamics we have investigated the behaviour of super cooled water on smooth and rough surfaces. Roughnesses of the order of 1-2 nm were created on graphite like surfaces. Water is modeled as monatomic water model. In particular, we investigate the role of surface fraction (fraction of solid on the interface) and roughness on the onset of crystallization while cooling from 270 K to 190 K with a cooling rate of 0.5-1K/ns. We also present in detail ice cluster growth and ice phases as observed for different rough surfaces.