Karlsruhe Institute of Technology

UNIVERSITY OF LEEDS

Institute of Fluid Mechanics istm

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Master-Thesis – experimetnal

Design and fabrication of patterned surfaces for advanced wetting functionalities

Background & Motivation

Micro/nano patterned surfaces have found increasing applications in various emerging technologies ranging from water harvesting to drag reducing and anti-frost coatings and antibacterial materials, thanks to their interesting functionalities related to wetting. Despite promising opportunities, the task of developing practical techniques to fabricate large area of such surfaces in a well-controlled and cost-effective manner still remains challenging. Top-down serial microfabrication techniques often rely on costly and time-consuming steps, and do not allow for facile spatial pattern variation. In comparison, fluid-based techniques are energy-efficient and inexpensive and can be used to fabricate patterns with diverse topographies and designs with diverse wetting behaviour (figure 1). Such approaches simply rely on phase transitions within thin films of fluids. However, the coupling between the physics of fluid, in methods such as spray-, spin-, and dip- coating, and thermodynamics of phase change is yet to be fully understood. How does the thickness of the film, rate of phase change and environmental conditions impact the final surface roughness? If and how the classical models of coating can be used to guide the application of fluid-based patterning technique to curved, porous and rough substrates (figure 2)?

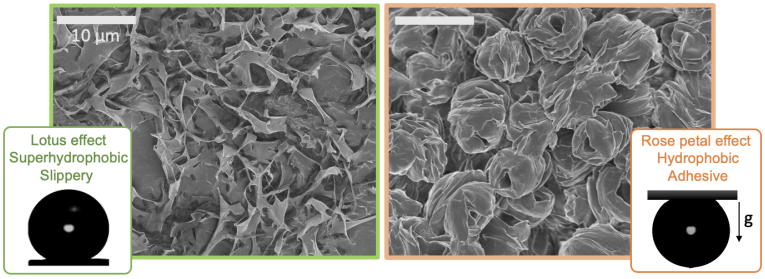

Figure 1: Diverse surface micro-topographies generated through fluid-based techniques showing slippery [left] and sticky [right] wetting behaviour.

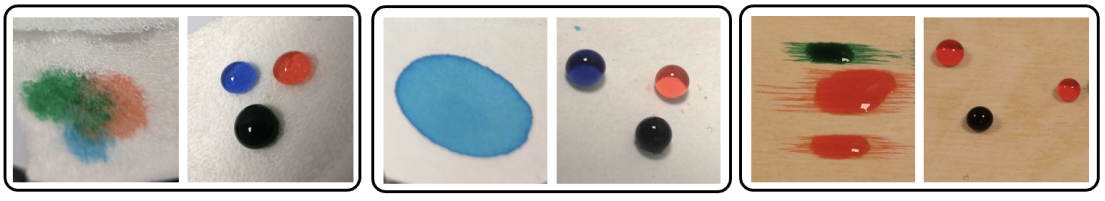

Figure 2: Fluid-driven surface patterning techniques trialled for superhydrophobic coating on cotton pad [left], filter paper [middle] and plywood [right].

Content of the Thesis
This project aims to fabricate micro-patterned surfaces using fluid-based techniques, and analyse their static and dynamic wetting behaviour. The student will investigate and compare the effectiveness of various coating techniques for solution of organic colloids, in order to generate micro and nano patterned surface roughness. The student will characterise the surface topographies using optical profilometry, as well as scanning electron (SEM) and atomic force (AFM) microscopy. For the micro-patterned surfaces, the student will analyse the surface wettability using experimental methods with the final goal of linking the coating process to surface roughness and its impact of wetting functionalities of the surface.

This project will be carried out in cooperation with Dr S. Khodaparast from the University of Leeds.

Start date:

Submission date:

Student:
Matrikel-Nr:

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Signature

Contact:
Dr.-Ing. Jochen Kriegseis
Dr.-Ing. Alexander Stroh

Institute of Fluid Mechanics
Kaiserstraße 10,
Building 10.23, 6th floor,
Room 601

☎ +49 721 608 43528
✉ alexander.stroh@kit.edu