I²CNER Webinar

International Institute for Carbon-Neutral Energy Research (WPI-I²CNER)
Kyushu University

Title **Droplets on Micro-decorated Surfaces: Wetting and Phase-Change**

Speaker Prof. Daniel Orejon
Institute for Multiscale Thermofluids, School of Engineering, University of Edinburgh, UK

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Abstract

The close interactions between liquids droplets and films, and solid surfaces are ubiquitous and play a paramount role in many everyday domestic and industrial applications closely related to thermal management, water treatment and harvesting, energy generation, etc.

In this talk I introduce efforts focusing on the systematic fundamental understanding of solid surface intrinsic wettability and micro-features, fluid surface tension, as well as the surrounding ambient, on the wettability and phase-change of small sized droplets following different micro-fabrication approaches. Deterministic deep reactive ion etching, stochastic wet etching and soft lithography enabling the replication of either stochastic or deterministic features are presented. Droplets on deterministic homogeneous structured surfaces adopt different wetting regimes and geometries, which can be tailored by varying the surface tension of the fluid or the surface ambient exposure. The wetting regime and droplet geometry eventually play a role on the evaporation mode and on the deposits.

The use of soft-lithography for the replication of the deterministic structures of the Dalenii or dragon's head sword lily's leaf are also introduced and the performance of the replicated surfaces under condensation phase-change and fog harvesting are compared and discussed. Further, easy and scalable chemical etching enabling the growth of stochastic hierarchical features is also studied. This process is able to create two different surfaces that resemble the lots leaf "super-repellent" and the rose petal "sticky" wetting behaviors. The wettability, wetting regime and condensation performance on these surfaces can also be tailored depending on the exposure to the ambient conditions. Last, the synergistic cooperation of wettability gradient surfaces and low adhesion lubricant infused surfaces and the use of lubricant infused phase-change materials where the wettability, adhesion and heat transfer can be tailored via the phase of the infused material are also briefly reviewed.

Wetting and non-wetting surfaces and mechanisms introduced here suggest promising capabilities for microfluidics, self-cleaning, thermal management as well as condensation phase-change applications.

About the Speaker

Daniel Orejon (Dani) holds a 5-year bachelor's degree in Environmental and Industrial Chemical Engineering from the University of Seville (Spain). After graduating, Dani spent a year as Graduate Research Assistant at the Institute for Energy Systems at the University of Edinburgh (UoE) and thereafter he completed his PhD on the fundamentals of evaporation phase-change at the droplet scale at the Institute for Materials and Processes at the UoE in 2013. Right after, Dani joined the International Institute for Carbon-Neutral Energy Research (WPI-I²CNER) at Kyushu University in Japan as a Post-Doctoral Research Associate where he shifted his research efforts towards condensation phase-change as well. In 2016, he became Assistant Professor at I²CNER Kyushu University (Japan) and 2 years later, he joined the Institute for Multiscale Thermofluids (IMT) at the UoE as a Lecturer in Chemical Engineering. Dani is currently a Senior Lecturer and serves as School Postgraduate Progression Committee representative for the IMT and as Teaching Laboratory Manager for the Chemical Engineering Discipline. In addition, Dani has been appointed as WPI-I²CNER Visiting Associate Professor, Associate Editor for the International Journal of Heat and Mass Transfer, and Fellow of the Higher Education Academy.

Dani's research interests embrace interfacial phenomena between liquid films/droplets and solid surfaces paying special attention to the effect of surface wettability and structure, liquid nature and surrounding environment on the fundamentals mechanisms of wetting and spreading encompassing evaporation and/or condensation phase-change. He focuses on the relevant interactions at different length-scales from the micro- to the nano-scale as well as on the thermophyiscal properties of all three solid, liquid and gas phases present, for interfacial mass and thermal transport related applications. Dani received the Young and Early-Career Scientists Kakenhi award twice, has received a Royal Society Research Grant and is currently participating in the SciSpacE Microgravity Application Promotion Programme from the European Space Agency (ESA).

Registration https://zoom.us/webinar/register/WN_LhA-GZV1S1aazaEas0mJfg

Host Prof. Yasuyuki Takata

Contact I²CNER・Q-PIT Office of Research Support Services,
Research Support and Public Relations
TEL: +81 92 802-6935
Email: iq-kenkyu@jimu.kyushu-u.ac.jp