COLLEGE OF ENGINEERING

Research Seminar Series

University of Nebraska-Lincoln
Department of Chemical and Biomolecular Engineering

Designing Surfaces with Extreme Wettabilities

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5:00-6:00 p.m.
Othmer Hall, Room 106
**Refreshments provided*

Abstract

In this talk I will discuss the current work in my group on developing surfaces with extreme wettabilities, i.e. surfaces that are either completely wet by, or completely repel, different liquids. The first portion of the talk will cover the design of so called "*superomniphobic surfaces*" i.e. surfaces which repel all liquids. Designing and producing textured surfaces that can resist wetting by low surface tension liquids such as various oils or alcohols has been a significant challenge in materials science, and no examples of such surfaces exist in nature. As part of this work, I explain how re-entrant surface curvature, in addition to surface chemistry and roughness, can be used to design surfaces that cause virtually all liquids, including oils, alcohols, water, concentrated organic and inorganic acids, bases, solvents, as well as, viscoelastic polymer solutions to roll-off and bounce.

A transparent superomniphobic coating applied on top of an iPhone® screen.

The second portion of my talk will cover the design of the first-ever reconfigurable membranes that, counter-intuitively, are both *superhydrophilic* (i.e., water contact angles ≅ 0°) *and superoleophobic* (i.e., oil contact angles > 150°). This makes these porous surfaces ideal for gravity-based separation of oil and water as they allow the higher density liquid (water) to flow through while retaining the lower density liquid (oil). These fouling-resistant membranes can separate, for the first time, a range of different oil–water mixtures, including emulsions, in a single-unit operation, with >99.9% separation efficiency, by using the difference in capillary forces acting on the oil and water phases. As the separation methodology is solely gravity-driven, it is expected to be one of the most energy-efficient technologies for oil-water separation.

I will also discuss surfaces with patterned wettability, where both wetting (omniphilic) and non-wetting (omniphobic) domains are fabricated on the same substrate. We use such substrates for fabricating monodisperse, multi-phasic, micro- and nano-particles possessing virtually any desired composition, projected shape, modulus, and dimensions as small as 25 nm. Finally, I will discuss some other areas of current and future research, including the development of *ice-phobic* coatings that offer one of the lowest reported adhesion strengths with ice.