The Department of Mechanical Engineering / College of Engineering and Applied Sciences
Stony Brook University

Mechanical Engineering Seminar
Faculty Candidate

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Highly Efficient Nanostructured "Smart Coatings" by Self-Assembly Fabrication

Thursday, May 12, 2016 at 10:45AM, Room 173 Light Engineering Building

Abstract

A current challenge in materials science is the fabrication of highly efficient "smart surfaces" with extreme and reconfigurable wetting, adhesion, and friction properties. Here we demonstrate novel, large area superhydrophobic/anti-icing silicon surfaces with ~20 nm feature size defined by using block-copolymer self-assembly and plasma etching. We investigate by means of optical and scanning probe microscopies, and x-ray scattering how the nanoscale texture morphology influences macroscopic water wettability and slippage, resistance to water infiltration under (static and dynamic) pressure, and freezing temperature/time of supercooled water drops. Our findings show that fine-tuning the texture morphology through control of the etching process is crucial to optimal superhydrophobic, anti-icing, and water slippage properties. Further, the extreme miniaturization of the feature size dramatically improves the surface resilience to water infiltration and ice formation. We discuss the implications of these results for the design of more efficient superhydrophobic/anti-icing coatings and nanofluidic devices for electrokinetic energy conversion.

Biography

Antonio Checco received his MSci Degree (Physics) from University of Calabria (Italy) in 1998 and his PhD (Physics) from the University Pierre et Marie Curie Paris 6 (France) in 2003 with an experimental thesis on the nanoscale wetting properties of self-assembled monolayer coatings (awarded the 2005 "Pierre Favard" Prize of the French Society of Microscopy). He then joined Brookhaven National Laboratory as a post-doctoral fellow in 2003. In 2006 he was promoted to Assistant Physicist and raised through the ranks to become Physicist with continuing appointment in 2014. His research focuses on structure-properties relationships of soft matter (liquids, colloids, polymers) at interfaces and under nano-confinement, as well as devising novel means of chemical and topographical surface nanopatterning based on self-assembly strategies. At Brookhaven he has also developed experimental techniques for in situ and in operando structural characterization of supported polymer thin-films, biomaterials, and nanostructured surfaces based on scanning probe microscopy and x-ray scattering.

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