



**Seminar Topic:  
Lubricant-Infused Materials to Combat Marine Biofouling**

**Associate Professor Ali Miserez**

### **Abstract**

Marine biofouling has been a vexing issue for decades. The large variety of marine organisms (*e.g.* mussels, barnacles, tubeworms) which can efficiently attach to immersed surfaces, such as ship hulls or port infrastructure, increase hydrodynamic drag and the weight of ships, or clog critical piping structures. In turn, biofouling results in high cost for the maritime industry and is responsible for increased greenhouse emissions. It is also directly responsible for the translocation of invasive species.

If one wants to tackle biofouling by developing efficient coatings which deter or minimize fouling, it is critical to understand the fouling process of macro-fouling organisms across multiple length scales, from the molecular level of adsorption on solid substrates, as done in our laboratory, to the meso-scale of adhesion phenomena to field studies. Biofouling also entices captivating questions with regard to the mechano-sensing ability of fouling organisms onto solid surfaces.

In this talk, I will present our recent efforts in using the concept of Slippery, Liquid-Infused Porous Surfaces (SLIPS) to combat marine biofouling, which uses mussels as a model organism to unveil the multiscale mechanisms of fouling prevention. I will present recent results showing that slippery surfaces are remarkably effective in preventing marine fouling in both laboratory and field conditions. Detailed investigations across multiple length scales – from the molecular scale characterization of deposited adhesive proteins, to nanoscale contact mechanics, to macroscale live observations – provide new insights into the physical mechanisms underlying the adhesion prevention. In particular, I will discuss how lubricant-infusion considerably reduces fouling by deceiving the mechano-sensing ability of mussels, therefore deterring secretion of adhesive threads, as well as how the infused lubricant decreases the molecular work of adhesion and macroscopic adhesion.

### **Biography**

Dr Ali Miserez is an Associate Professor in the School of Materials Science and Engineering and School of Biological Sciences at Nanyang Technological University, Singapore. He graduated from the Ecole Polytechnique Fédérale de Lausanne (EPFL, Switzerland) with a PhD (2003) in Materials Science and Engineering in the field of composite materials and mechanics of materials. In 2004, he received a Swiss National Science Foundation post-doctoral fellowship and moved to the University of California, Santa Barbara (UCSB), where he was affiliated with the Materials Department and the Marine Science Institute. At UCSB, he expanded his research interest towards biomimetic materials and the biochemistry of extracellular tissues. He moved to NTU as an Assistant Professor in 2009, and in 2011, he was awarded the Singapore National Research Foundation (NRF) Fellowship, a highly-competitive \$3M individual research grant for early career scientists.

Dr Miserez's research is centred on revealing the molecular, physico-chemical and structural principles from unique biological materials, and on translating these designs into novel biomimetic synthesis strategies. His research group is strongly cross-disciplinary with molecular biologists, chemists, bio-physicists, and materials scientists combining their expertise towards bioinspired engineering from various angles, including protein biochemistry, extracellular tissue transcriptomic, polymer chemistry, biomimetic peptide design, biophysics, and nanomechanics. In recent years, his work has appeared in both general (*Science, Nature Materials, Nature Biotechnology, Nature Chemical Biology, Advanced Materials*) and specialized journals (*Biomacromolecules, ACS Nano, JBC, Polymer Chemistry, etc.*). He has delivered numerous invited talks, including at various Gordon Research Conferences in the field of bioinspired materials and biomineralization.

**Wednesday, 5 September 2018 || Time: 2:00 pm – 3:00 pm**  
**Venue: MSE Meeting Room (N4.1-01-28)**  
**Hosted by: Associate Professor Alfred Tok ling Yoong**

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