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Achieving dual phobic surfaces using nanostructured composite coatings

There is a significant surge in developing surfaces that can repel water and air – more particularly repelling oil in underwater systems. We have developed a composite nano-coating consisting of camphor soot particles embedded in PDMS matrix. Through proper curing process, we have demonstrated that such composite surface has self-cleaning properties with a water contact angle of 171°. It showed excellent retention of superhydrophobicity against the impact of sand particles from a height of 10–70 cm and maintained the wetting characteristics against strong acid treatment. We further performed detailed investigation of the mechanical responses of the camphor soot particle-incorporated PDMS composites by using atomic force microscopy (AFM). Using an AFM tip with a radius of approximately 10 nm, we have quantified different mechanical properties such as stiffness, the plastic work, and the effective adhesive work. Through these detailed characterization, we have also demonstrated the self-healing properties of the nanocomposite. Further modifications and chemical treatment of the composite coating provided excellent pathways towards under-water oleophobic characteristics. We have performed detailed wetting measurements in terms of Cassie-Baxter and Wenzel states of the under-water oil drops to demonstrate such underliquid wettability. This low cost, environment friendly composite coating has large number of applications ranging from marine systems to anti-rust coatings.



Figure 1: Showing the wetting characteristics of the nano-composite coating.

Biography

Prof. Sushanta K. Mitra is currently working as Executive Director, Waterloo Institute for Nanotechnology, Canada is the former Associate Vice-President Research and Kaneff Professor in Micro & Nanotechnology for Social Innovation at the York University. His research interests are in the fundamental understanding of fluid transport in micro and nano-scale confinements with applications in energy, environmental monitoring, and bio-systems. For his contributions in engineering and sciences, he has been elected as the Fellow of the American Society of Mechanical Engineers (ASME), the Canadian Society for Mechanical Engineering (CSME), the Engineering Institute of Canada (EIC), the Canadian Academy for Engineering (CAE), the Royal Society of Chemistry (RSC), and the American Association for the Advancement of Science (AAAS). He is also a Fellow of the National Institute for Nanotechnology (NINT) and the recipient of 2015 Engineering Excellence Medal from the Ontario Society of Professional Engineers.

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