ME Seminar

Extreme wetting surfaces and liquid interfaces: mechanistic understanding and applications

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ABSTRACT

Inspired by nature, extreme-wetting (superomniphobic/superomniphilic) surfaces have received significant interest in recent times. These surfaces offer excellent wettability control and therefore have a great significance from fundamental research to applications. Hence, a fundamental understanding of extreme wetting surfaces is of great relevance. In my Ph.D. thesis, a simple, inexpensive, and rapid method for the fabrication of a superhydrophobic (SHB) surface and its reversible transition to a superhydrophilic (SHL) surface is reported. A mechanistic understanding of the superhydrophobicity and superhydrophilicity, and the reversible transition between these two wetting states is provided. Then the dynamics of the liquid interface over SHB-SHL surfaces are extensively studied. Firstly, wetting dynamics and stability of an aqueous droplet over an SHL-SHB composite surface are reported as classical Wenzel, and Cassie-Baxter equations do not satisfy here. Secondly, the dynamics of the capillary flow in superwetting channels is investigated. Next, a comprehensive analysis of the interaction and manipulation of microdroplets over extreme wetting surfaces is reported. Here, firstly, the evaporation-induced interaction and manipulation of aqueous droplets over superhydrophilic surface are reported. Further, interactions of microdroplets on an immiscible liquid impregnating extreme wetting surface are presented. Then, electrostatic interaction between SHL surface and liquids is proposed. In addition to various fundamental studies, the facile surface fabricated in the present study can find applications in various fields, from fluidics to biology. Firstly, the effect of surface energy and surface roughness on cell growth and proliferation is studied by culturing different cell lines on these surfaces. Further, the proposed SHL surface is used for different antigen-antibody binding for different disease detection (like dengue), and SHB surface is used for protein extraction from whole blood. Finally, the proposed SHB-SHL surfaces are used to separate oil-water emulsion and on-surface biological cargo transport.

ABOUT THE SPEAKER

Dr. Butunath Majhy completed his Ph.D. in microfluidics from the Department of Mechanical Engineering at the Indian Institute of Technology Madras, working with Prof. Ashis Kumar Sen. Subsequently, he worked as a post-doctoral equivalent fellow and a project scientist at IIT Madras before joining as a post-doctoral fellow at the University of Alberta, Canada. Prior to his PhD, Dr. Majhy completed his M.Tech. from the National Institute of Technology Rourkela.

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