INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

Various bio-inspired extremes of liquid wettabilities, including superhydrophobicity, underwater superoleophobicity/superoleophilicity, and so on are of enormous potential for diverse applications, including oil-transportation, oil-water separation, fabrication of robotic devices, anti-bio fouling coatings, microfluidics and so forth. In the past decades, such liquid wettabilities have been designed following various top-down and bottom-up approaches. The appropriate co-optimization of hierarchical topography and surface chemistry is the primary requisite for adopting desired and extremes liquid wettabilities. A low surface energy coating is mainly required for designing superhydrophobic or underwater superoleophilic surface, whereas high surface energy coating is needed for achieving underwater superoleophobic surface. In the past, distinct synthetic approaches were followed for preparing different bio-inspired (e.g., fish-scale-inspired coating, lotus-leaf-inspired coating etc.) coatings. Moreover, synthesis of physically/chemically durable biomimicked wettability is highly important for various prospective applications at practically relevant scenarios. Thus, a common and facile synthetic approach is essential for adopting durable and different extremes of liquid wettabilities, where a simple and robust chemistry would be allowed to tailor diverse liquid wettabilities. In this synopsis report, we have summarized a facile and common chemical approach for achieving various durable bio-mimicked wettabilities, where 1,4-conjugate addition reaction between amine and acrylate groups was successfully extended for constructing covalently cross-linked and chemically-reactive multilayered coatings. This synopsis report with a title of '**Chemically-Reactive Polymeric Multilayered Coatings for Tailoring Durable Liquid Wettabilities'** is segregated into six chapters. ***Chapter 1*** includes an introduction to the fundamentals of various biomimicked liquid wettabilities and a brief overview on conventional techniques for achieving such biomimicked wattability. The existing challenges related to the bio-inspired liquid wettability has also been also discussed in this chapter. In ***chapter 2***, chemically-reactive polymeric nanocomplexes (CRPNC) were integrated into a multilayered coating (20-bilayers, each bilayer represents the deposition of CRPNC and branched polyethyleneimine (BPEI)) through subsequent deposition of BPEI and CRPNC following a covalent layer-by-layer (LBL) deposition process. The post-covalent modification of the multilayered coating with glucamine through facile and robust 1,4-conjugate addition reaction allowed to adopt a bulk underwater superoleophobicity. The underwater superoleophobic coating remained highly durable towards both harsh physical abrasions (including adhesive tape peeling test, sand paper abrasion test etc.) and various complex chemical exposures like extremes of pH (pH 1, pH 12), artificial sea-water, river water, etc. Next, in ***Chapter 3****,* this abrasion tolerant underwater superoleophobic coating was successfully deposited on a stretchable and fibrous matrix for developing a deformable and durable underwater superoleophobic membrane for gravity-driven and environmentally-friendly separation of various oil-water mixtures under practically relevant severe settings. However, this synthesized multilayered coating failed to display superhydrophobicity even after post covalent modification with alkylamine having a long hydrocarbon tail. ***Chapter 4*** accounts a salt (NaCl)-assisted and high throughput synthesis of chemically-reactive multilayered (9 bilayers) coating with optimum topography to display both underwater superoleophobicity and superhydrophobicity. A controlled and selective post-covalent modification of this chemically-reactive multilayered coating allowed to adopt substrate independent and two different bio-mimicked liquids wettabilities. A continuous trapped air layer present in superhydrophobic interfaces is generally considered as the primary basis for achieving another super liquid wettability—that is underwater superoleophilicity. ***Chapter 5*** includes a detailed systematic study to investigate the essential requirements for fabricating a durable underwater superoleophilicity. The detailed study validated that a hydrophobic multilayered coating (consisting of 20 bilayers, octadecylamine-modified) with discontinuous trapped air was also capable of displaying durable underwater super-oil-affinity. Moreover, the stability of this extreme oil-wettability was superior over superhydrophobic multilayered coating (consisting of 9 bilayers, octadecylamine-modified). The hydrophobic multilayered coating (20 bilayer) remained highly selective to oil phase under water as similar to superhydrophobic coating. Further, this durable underwater superoleophilicity was extended to develop a super-oil-absorbent for comprehensive oil/water separation under practically relevant severe settings. In ***Chapter 6***, a brief overview of the thesis work has been presented along with the prospective applications of this chemically-reactive multilayered coatings that will be explored in future.