



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title:
Design of Coatings Embedded with Tolerant, Tailored and Responsive Underwater Oil Wettability and Oil Adhesion

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SHORT ABSTRACT

The anti-oil wettability of various naturally existing underwater creatures has inspired researchers to develop artificial super oil repellent interfaces for multiple applications in engineering, healthcare, and environmental remediation. In the past, several approaches were adopted to artificially fabricate underwater oil-repellent surfaces, formally known as underwater superoleophobicity, by co-optimizing hydrophilic chemical composition and rough micro/nano-structures on their surface. However, the earlier reported approaches in deriving underwater superoleophobicity were unable to associate some other essential properties, such as, physical and chemical durability, adaptive tuning of oil adhesion, and transparency in the prepared surfaces. Here, a facile 1, 4-conjugate addition reaction is exploited to derive covalently crosslinked chemically reactive coatings on various surfaces loaded with residual chemical functionalities that provide the opportunity to embed underwater superoleophobicity through appropriate post-covalent modifications. While the covalent crosslinking tailored mechanical property, the adequate chemical post-modification customized oil adhesion and optical transparency. The thesis entitled "Design of Coatings Embedded with Tolerant, Tailored and Responsive Underwater Oil Wettability and Oil Adhesion" is presented in six chapters. Chapter 1 introduces bio-mimicked underwater superoleophobic surfaces, the existing challenges associated with conventional artificial fabrication approaches, and the objectives of the thesis work. Chapter 2 demonstrates the fabrication of a dually reactive multilayer coating following the 1, 4-conjugate addition reaction and the post-covalent modification of the multilayer coating to immobilize highly sensitive bare micro-meter sized nematic liquid crystal (LC) droplets underwater for single LC droplet based repetitive sensing application. Chapter 3 accounts for the utilization of the dually reactive multilayer coating to develop various responsive underwater superoleophobic surfaces via post-modifications and their adaptive oil adhesion for sensing different amphiphilic (cationic, anionic and facial) molecules. Chapter 4 demonstrates the rational functionalization of the dual reactive multilayer coating to depict the highly selective raising of the oil contact angle (OCA) and rolling of a beaded oil droplet underwater in the presence of targeted and relevant toxic chemicals. Chapter 5 introduces a covalently crosslinked and chemically reactive sol-gel conversion process through the 1, 4-conjugate addition reaction to achieve a substrate-independent,

mechanically durable, and optical transparent coating embedded with underwater superoleophobicity. Moreover, this approach allows to modulate mechanical property of highly deformable objects. Chapter 6 provides a brief summary and the future outlook of the work presented here.

