INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

Name of the Student : **ARPITA SHOME**

Roll Number : **176122042**

Programme of Study : **Ph.D.**

Thesis Title: **Bio-Inspired Anti-Wetting Materials Derived from Natural Components**

Name of Thesis Supervisor(s) : **DR. UTTAM MANNA**

Thesis Submitted to the Department/ Center : **CHEMISTRY**

Date of completion of Thesis Viva-Voce Exam : **02-08-2022**

Key words for description of Thesis Work : **BIO-INSPIRED, ANTI-WETTING, FUNCTIONAL MATERIALS**

SHORT ABSTRACT

The existence of liquid repellent interfaces in nature has stimulated widespread research towards fabrication of bio-inspired anti-wetting materials utilizing numerous synthetic and naturally derived components. However, the earlier reported approaches of naturally derived bio-inpsired materials suffer from durability concerns on prolonged exposure to challenging physical and aqueous chemical settings. Most importantly, the existing approaches mostly fail to provide a facile basis to further induce the desired chemical functionalities in the interfaces 'three-dimensionally' to tailor the liquid wettability and modulate other physical parameters. The substitution of synthetic components with naturally derived eco-friendly alternatives with residual reactivity to tailor both the liquid wettability and mechanical property for developing robust bio-inspired anti-wetting materials can prove vital for biomedical applications and tackling environmental issues. In this thesis, I have strategically exploited low-cost, naturally abundant polymers and hydrogel to develop robust, three-dimensional, abrasion-tolerant anti-wetting materials exploiting the catalyst-free Michael addition reaction and facile Schiff base reaction. The use of Michael addition reaction allowed the 'three-dimensional' induction of residual chemical reactivity into the substrates that gave the opportunity to tailor the liquid wettability through appropriate post covalent modification with the desired chemical functionalities and even modulate the mechanical property. The thesis entitled 'Bio-Inspired Anti-Wetting Materials Derived from Natural Components' is divided into seven chapters. Chapter 1 introduces the basics of liquid wettability, the challenges associated with the existing bio-mimicked anti-wetting materials and the probable solutions. In Chapter 2, I have developed 'reactive' protein nanoparticles for obtaining robust superhydrophobicity wherein the presence of 'reactivity' allowed to tailor the water wettability for controlled release of bioactive molecules. In Chapter 3, I have utilized the silk-biopolymer to construct mechanically tailorable sponges through ethanol assisted embedment of beta sheet structures. The same mechanically tailorable sponges were rendered with chemical reactivity through Michael addition reaction to allow the modulation of water wettability. In Chapter 4, I judiciously aimed for waste management by exploiting facile chemical approach to convert waste paper into mechanically tailorable, superhydrophobic sponges for resolving another major environmental concern of oil spillage. In Chapter 5, BSA protein and Schiff base reaction were strategically extended for developing sustainable underwater

superoleophobicity. In Chapter 6, the underwater superoleophobic property of Aloe Vera mucilage was discovered and directly utilized for fabricating stretchable and abrasion tolerant underwater oil repellent coatings for filtration-based oil/water separation. Chapter 7 summarizes the thesis works and provides a futuristic direction to the existing works discussed in the thesis.