INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: Facile Synthesis of Durable and Bulk Superhydrophobic Materials

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SHORT ABSTRACT

In the past, lotus leaf-inspired extremely water-repellent property that is widely recognized as superhydrophobicity, provided a facile basis for developing various functional materials. However, the synthesis of durable artificial superhydrophobic interfaces following a facile and scalable procedure is the major Achilles' heel at the helm of its practical use in severe and diverse scenarios. Here, I have rationally exploited a facile chemical reaction that is Michael addition reaction between acrylate and amine groups in developing highly durable and bulk superhydrophobic materials for various practical applications. The polymeric material with extremely water repellant property was synthesized using a salt doped gelation approach followed by appropriate post chemical modification with an amine containing small molecules. The anti-wetting property remained intact even after exposure to various physical and chemical insults. Moreover, various physical properties (rate of gelation, shrinkage, porosity, mechanical strength) of the polymeric material was tuned with alteration in the alcoholic solvent of the reaction medium and was found the rate of gelation, mechanical durability and the anti-wetting property significantly enhanced with increase in the alkyl chain of the alcoholic solvent. Additionally, a facile chemical approach was developed to fabricate durable and bulk superhydrophobic coating on various planar objects without using any external solvent and catalyst. The synthesized coating was highly durable against various physical and chemical insults. Moreover, a stretchable and durable superhydrophobic membrane was fabricated by immobilization of reactive nanocomplexes on the polyurethane (PU) fibrous substrate followed by octadecylamine (ODA) treatment. The embedded anti-wetting property remained intact after various physical (bending, twisting, creasing, sand paper abrasion, adhesive tape peeling and so an) and chemical (pH, 12) insults and even after 150% of stretching. Afterwards, the stretchable membrane was explored for gravity driven oil/water separation and the separation efficiency remains above 99% irrespective of the contaminations of the aqueous phase. Furthermore, a single superhydrophobic material was fabricated from the naturally abundant, porous and fibrous substrate (i, e, medical cotton) for both absorption and filtration-based oil/water separation. The as synthesized superhydrophobic cotton displayed highly durable anti-wetting property against various physical and chemical insults. Subsequently, the durable superhydrophobic cotton was explored for absorption and filtration-based oil/water and the oil separation efficiency was above 95% for 100 consecutive cycles of separation without compromising its embeded water repellant property. Hence, the approach developed in the current thesis to synthesize the durable and bulk superhydrophobic materials will be useful for various prospective applications at practical settings.