BIONIC POLYMER MATERIALS AND THEIR SUPERHYDROPHOCITY

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ABSTRACT

Nature always gives us inspirations for fabricating functional materials by mimicking the structure design or stimuli-responsive capability of biomaterials. However, the strict preparation conditions, multi-step processes and high cost of the methods to create biomimetic systems at interface and in bulk, limited their practical applications. Therefore, developing simple, cheap but effective method becomes the focus of our research in this field. In this feature article, facile methods for creating lotus-leaf-like micro-nano-binary structured superhydrophobic or superamphiphobic surfaces based on different mechanisms, i.e., solvent induced phase separation of blend polymer solution, self-assemble of copolymer micelle solution, solvent induced crystallization, were summarized. Moreover, some progresses in investigation on the special microstructure induced unique wetting properties were also introduced. As an effective biomimetic bulk system, a unique swift stimuli-responsive gel actuator was developed under un-contact electronic field in air. Artificial muscles with path-controlled or self-governing long-range locomotion can be realized by using these stimuli-responsive polymer gels on the basis of the extraordinary driving mechanisms.

As a fundamental property of solid surface, wettability plays an important role in daily life, industry, and agriculture. Hence, functional surfaces with special wettabilities like superhydrophobicity and superamphiphobicity have attracted lots of research interests because of their great advantages in applications, such as self-cleaning effect, anti-adhesion, anti-erosion, current-conduction inhibition, *etc*.[1-2] It has been recognized that the cooperation between the surface chemical composition and the topographic structure is crucial to construct special wettability.[3] Results of biomimetic research also indicated that many phenomena regarding special wettabilities in nature are related to the unique micro- and nano-scale structure on the solid surfaces. For example, the special superhydrophobic wettability of lotus leaf covered with common hydrophobic epicuticular wax is mainly resulted from the particular surface structure, in which there exist many papillae in a diameter of 3-10 μm, decorated with smaller protrusions of nanometer size. Such special micro-nano-binary structure (MNBS) enhances the surface roughness dramatically and traps the air in the grooves underneath the liquid that largely minimizes the contact area between the leaf and the liquid.[1a,2b,4] In order to mimic the Lotus-effect, theoretical analyses had been developed to offer some inspirations for the structure design, while experimental attempts were also made to create biomimetic superhydrophobic surfaces by combination of depressed surface energy and enhanced surface roughness. Conventionally, two strategies are adopted, one is creating micro-/nanostructure on the hydrophobic substrate, and the other is chemically modifying the micro-/nano-structured surface with a special low surface energy material. However, the severe preparation conditions, multi-step processes, expensive low surface energy materials, and high cost of the previous methods limit the practical application of superhydrophobic surfaces in large-area. Therefore, how to obtain biomimetic superhydrophobic surfaces facilely and economically still remains a challenge. Meanwhile, in order to develop their potential practical applications, comprehensive investigations on the special microstructure induced unique wetting properties still need to be carried out. Herein, some facile methods for fabrication of superhydrophobic surfaces under ambition conditions in large area were presented. And some special wetting properties for superhydrophobic surfaces were also investigated.

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