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Bioinspired gradient surfaces with controlling of dynamic wettability

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Biological surfaces create the enigmatical reality to be contributed to learning of human beings. They run cooperate between of endlessly arranged various-style gradient micro- and nanostructures (MN) that greatly provide with excellent functions via natural evolvement. Such biological surfaces with multi-gradient micro- and nanostructures display unique wetting functions in nature for water collection and water repellency, which have inspired researchers to design originality of materials for promising future. In nature, a combination of multiple gradients in a periodic spindle-knot structure take on surface of spider silk after wet-rebuilding process in mist. This structure drives tiny water droplets directionally toward the spindle-knots for highly efficient water collection. Inspired by the roles of gradient MNs in the water collecting ability of spider silk, a series of functional fibers with unique wettability has been designed by various improved techniques such as dip-coating, fluid-coating, tilt-angle coating, electro-spun and self-assembly, to combine the Rayleigh instability theory. The geometrically-engineered thin fibers display a strong water capturing ability than previously thought. The bead-on-string hetero-structured fibers are capable of intelligently responding to environmental changes in humidity. Also a long-range gradient-step spindle-knotted fiber can be driven droplet directionally in a long range. An electro-spun fiber at micro-level can be fabricated by the self-assembly wet-rebuilt process, thus the fiber displays strong hanging-droplet ability. The temperature or photo or roughness-responsive fibers can achieve a controlling on droplet driving in directions, which contribute to water collection in efficiency. Besides inspired by gradient effects on butterfly wing and lotus leaves, the surfaces with ratchet MN, flexible lotus-like MN are fabricated successfully by improved methods, which demonstrate that the gradient MN effect rises up distinctly anti-icing, ice-phobic and de-ice abilities. These multifunctional materials can be designed and fabricated for promising applications such as water-collecting, anti-icing, anti-frosting or anti-fogging properties for practical applications in aerospace, industry and so on.

Biography

Yongmei Zheng is a Professor at School of Chemistry and Environment, Beihang University. Her research interests are focused on "Bioinspired surfaces with gradient micro- and nanostructures to control dynamic wettability and develop the surfaces with characteristics of water repellency, anti-icing, anti-frosting or fog-harvesting, tiny droplet transport, water collection, fog-harvesting and so on". She has published more than 90 SCI papers in *Nature, Adv. Mater., Angew. Chem. Int. Ed., ACS Nano* and *Adv. Funct. Mater.*, etc., with 12 cover stories and a book "Bioinspired wettability surfaces: Development in micro- and nanostructures" by Pan Standard Publishing, USA. Her work was highlighted as Scientist on News of Royal Society of Chemistry, Chemistry World in 2014. She is a senior member of Chinese Composite Materials Society (CSCM), member of Chinese Chemistry Society (CCS), American Chemistry Society (ACS), International Society of Bionic Engineering (ISBE) and International Association of Advanced Materials (IAAM). She wins an ISBE outstanding contribution award in 2016 by ISBE and an IAAM Medal in 2016 by IAAM, in Sweden.

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