

# Emerging Trends in Materials Science and Nanotechnology

January 28-29, 2019  
Barcelona, Spain

Nano Res Appl 2019, Volume 5  
DOI: 10.21767/2471-9838-C1-031

## Bioinspired micro and nanostructured surfaces with controllable dynamic wettability

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**B**iological surfaces create the enigmatical reality to be contributed to learning of human beings. Such biological surfaces with multi-gradient micro and nanostructures (MN) display unique wetting functions in nature, 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, electrospun 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 heterostructured 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 electrospun 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 by 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.

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