Bioinspired wettability gradient surfaces: From design to functions

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Biological surfaces in nature (e.g., spider silk, cactus spine, beetle back, butterfly wing, lotus leaf, etc.) have inspired us to design the functional materials and surfaces. Inspired by the structures of spider silk for directional water collecting ability, a series of bioinspired gradient fibers has been designed by integrating fabrication methods and technologies, e.g., dip-coating, Rayleigh instability break-droplets, electrospinning, and wet-assembly, etc., thus roughness and curvature, gradient spindle-knots, star-shape wettable pattern, etc. for droplet transport and harvesting. Inspired by cactus spines, the conical spines with periodic roughness or micro- and nanostructures can achieve the high-efficiency condensed-droplet transport. Some dynamic gradient surfaces are also designed, e.g., photo-thermal organogel surfaces for controlling of droplet transport in various routes *via* light radiation; Magnetic-induced dynamic tilt-angle pillar array for driving of the droplet shedding-off in directions. The bioinspired gradient surfaces can be further designed to exhibit robust transport and controlling of droplets. These bioinspired gradient surfaces would be promising applications into anti-icing, liquid transport, anti-fogging/self-cleaning, water harvesting, etc.