Bio-inspired surfaces with a function of transport and aggregation of droplets

Ming Liu  Shuai Wang  Shaohua Chen¹

Institute of advanced structure technology, Beijing Institute of Technology, Beijing, 100081, China

Micro- and nano-structures on natural surfaces, such as lotus leaf, spider silk and desert beetle’s back, contribute them excellent functions of wetting and droplet transport. Bionic design and preparation of a class of functional surfaces could be helpful for directional transport, precise control and aggregation of droplets, which should be useful in the field of microfluidic control, drug transport, heat dissipation of micro-nano devices and water collection.

Inspired by the water-collecting function of desert beetle’s back, we design a kind of functional surface with co-existing hydrophilic and hydrophobic zones, on which the main factors affecting surface wettability, droplet transportation and aggregation are studied through theoretical, simulation and experimental methods. A kind of surface with efficient water-collecting function is finally fabricated.

The work in this paper consists of several parts. Firstly, the dynamic behavior of droplets crossing the interface between hydrophilic and hydrophobic zones is studied theoretically and experimentally, and the dynamic morphology of droplets crossing the interface is accurately characterized. Secondly, a hydrophobic surface with wedge-shaped hydrophilic region inset is designed and fabricated, on which the spreading and transport behaviors of droplets are investigated. Behaviors of droplet transport and aggregation on a kind of functional surface with hierarchical hydrophilic zones are further considered, based on which the optimization design method of directional transport of droplets is proposed. Finally, a surface having the function of collecting water in fog is experimentally fabricated, which should be very useful in many fields, such as desert water harvesting and wilderness survival.

¹ Corresponding author. Email address: shchen@bit.edu.cn or chenshaohua72@hotmail.com