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Drop Impact Study on Flexible Superhydrophobic Surface Containing Micro-Nano Hierarchical Structures

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Abstract : Superhydrophobic surfaces are abundant in nature. Several surfaces such as wings of butterfly, legs of water strider, feet of gecko and the lotus leaf show extreme water repellence behaviour. Self-cleaning, stain-free fabrics, spill-resistant protective wears, drag reduction in micro-fluidic devices etc. are few applications of superhydrophobic surfaces. In order to design robust superhydrophobic surface, it is important to understand the interaction of water with superhydrophobic surface textures. In this work, we report a simple coating method for creating large-scale flexible superhydrophobic paper surface. The surface consists of multiple layers of silanized zirconia microparticles decorated with zirconia nanoparticles. Water contact angle as high as 159±10 and contact angle hysteresis less than 80 was observed. Drop impact studies on superhydrophobic paper surface were carried out by impinging water droplet and capturing its dynamics through high speed imaging. During the drop impact, the Weber number was varied from 20 to 80 by altering the impact velocity of the drop and the parameters such as contact time, normalized spread diameter were obtained. In contrast to earlier literature reports, we observed contact time to be dependent on impact velocity on superhydrophobic surface. Total contact time was split into two components as spread time and recoil time. The recoil time was found to be dependent on the impact velocity while the spread time on the surface did not show much variation with the impact velocity. Further, normalized spreading parameter was found to increase with increase in impact velocity.

Keywords : contact angle, contact angle hysteresis, contact time, superhydrophobic
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