Use of Patterned Super (hydrophobic) Surfaces in Digital Microfluidics

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Digital microfluidics (DMF) is an emerging liquid-handling technology that enables the manipulation of small, discrete droplets (picoliters to microliters) in a precise and reproducible manner. The important applications of DMF involve droplet dispensing, moving, splitting and mixing contents within a droplet. SH surfaces are used in DMF for facilitating magnetic actuation of droplets and formation of microarrays. A surface is considered superhydrophobic if a water droplet displays both a water contact angle ($\theta_{CA}$) >150°, and a sliding angle (SA) <10°. A high quality superhydrophobic, surface will have uniform pinned, and trapped air that produces a high contact angle (approaching 180°), a low sliding angle (approaching 0°), small contact angle hysteresis. Superhydrophobic surfaces generally require two essential features. The surface is composed of a low surface energy material with a micro or nanostructured (hierarchical) surface texture. SH surfaces provide low frictional forces between a liquid droplet and the surface itself allowing for actuation using minimal force. Magnetic actuation uses an external magnetic field to manipulate droplets containing magnetisable particles (MPs). The application of functionalized paramagnetic particles (PMP) in combination with magnetic separation techniques has received considerable attention in recent years. The use of magnetic particles is growing, especially in bio-applications due to large specific surface area for chemical binding and the ability to manipulate using magnetic fields. The first part of this talk will focus on a surface energy traps (SETs)-based magnetic droplet manipulation platform that enables both droplet confinement and MPs extraction. We the utilised this method to fractionate a peptide mixture produced by the tryptic digestion of the protein lysozyme. Second part of the talk will focus on the adhesion of aqueous and modified solvents on laser patterned superhydrophobic/hydrophillic substrates. We further demonstrate the use of a patterned surface for the quantitative determination of ethanol in beer samples.