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Digital Magnetofluidics: Nanotechnology To Make Medical Testing More Accessible

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Recently[1] our group announced the development of a new microfluidic method that relies on magnetic fields to control the horizontal, vertical, and upside-down movement of drops on superhydrophobic surfaces using magnetizable carbonyl iron microparticles that are introduced into the liquid. In addition, key elements of operations such as movement, coalescence, and splitting[2] of aqueous and biological fluid drops, as well as electrochemical measurement of an analyte are demonstrated. Electrochemical measurements are performed using a sequence of 'Sample', 'Blank', 'Wash' and 'Reagent' solutions that are moved into and out of a three-electrode assembly in order to perform square-wave voltammetry or chronoamperometry[3]. The creation of pH gradients that can be maintained during drop splitting also holds promise as a method for removing albumin from serum samples for blood analyses. This talk explains the physics of digital magnetofluidics, how superhydrophobic surfaces are made using nanowires and other nanostructures, and the potential for this technology in automated clinical diagnostics and as a means for rapid sample preparation in proteomics.

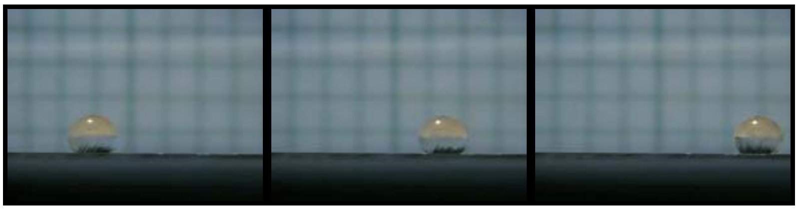
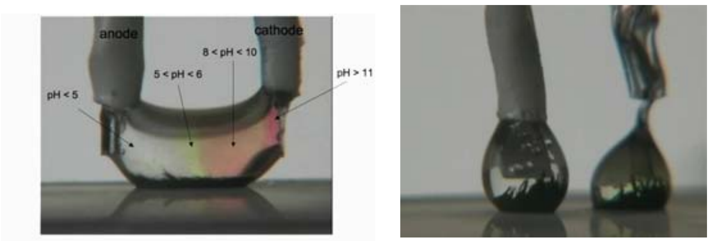


Figure 1. Still frames from a video showing aqueous solution drop movement using digital magnetofluidics. Speeds of up to 7 cm/s are possible as well as 3-D motion. The "open drop" nature of this method allows for ease of integration with electrode measurement. Drops of biological fluids can also be moved, split, coalesced and analyzed.



(a) (b)

Figure 2. Creation of pH gradient in a drop visualized using a rainbow indicator. With digital magnetofluidics a drop can be moved to the electrode assembly, a pH gradient can be established (a), and then the drop can be split (b) for protein analysis.

References

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