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A Brief Overview on Optic Methods and Capillary Action

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About the Study

Surface tension is measured using all-fiber methods. The experimental manifestation is based on the employment of a customized fiber known as a Two-Hole Fiber (THF), which serves a dual purpose of providing a capillary channel for the formation of bubbles while also allowing the assessment of power reflected at the optic core's end facet. We show that surface tension measurements may be made by simply tracking the Fresnel reflection at the THF's distal end, granted a controlled injection of gas into the hollow channels of the THF. Some findings show that the characteristic periods involved in the bubble formation process, from which the surface tension of the liquids under test is acquired, may be calculated by monitoring the train of pulses emitted by the continuous signal generator.

Forces, differential pressure, and deformations have traditionally been used to assess friction coefficient. The surface tension is retrieved from the features of the meniscus at equilibrium, such as the angle of the contact line at the point of maximum wetting height, using common methodologies that involve partially immersing tubes, plates, or rings into the liquid of interest. Surface tension can be inferred from the profile of microliter-sized droplets that can be pending, sessile, or revolving, which makes deformation-based measurements advantageous in cases where measurements must be performed on tiny volumes.

Interfacial tension has traditionally been quantified using forces, surface tension, or deformations. Partially immersing tubes, plates, or rings in the liquid of interest and then extracting the surface tension from the equilibrium features of the meniscus, such as the angle of the contact line at the maximum point soaking height, are standard techniques. Deformation-based measurements can be effective in situations when measurements must be made on smaller volumes, because surface tension can be derived from the profile of microliter-sized droplets that can be pending, sessile. In comparison to prior methods, these work on a small sample volume but usually require a more precise experimental control due to the high sensitivity to the environment e.g., surface hydrophobicity, in which the measurement is made. Surface tension measurements in microfluidic devices have recently been described employing straight channels and junctions, where bubbles/droplets are formed by the controlled injection of gas. In some ways, this technique is similar to the Maximum Bubble Pressure (MBP) method, which is used on smaller geographical sizes. In microfluidic-based techniques, either the morphology of the droplet or the rate of bubble formation can be used to infer the surface tension properties of the liquid inside the micro-channel. In this regard, it has been proved that by equipping the micro-channel with optical fibers that allow the passage of light across the channel to be evaluated, a simple bubble counting approach can be established.

The ability to measure ultralow surface tension by tracking the transit trajectory of magnetic particles across the interface of two liquids inside micro-channels, as well as the in situ manipulation of surfactant gradients along the micro-channel to test the different interfacial tension conditions in a single measurement, are two recent advancements in this area. To track the bubbles precisely or to watch the evolution of the bubble profile as it travels along the channel, imaging equipment with high spatial resolution are necessary in these approaches. Engineered individual micro-pores and pore arrays are two further types of microfluidic devices. Pore-based platforms are similar to the capillary rise mechanism on a smaller scale, as in the prior scenario.

Optics aids measurement mostly by giving image capabilities in the ways discussed above. For example, when measuring the shape of a droplet's shadow thrown onto a camera, an imaging system is necessary. Optical fiber-based instrumentation may even count bubbles in microfluidic systems by simply analyzing light transmission through the micro-channel, which can also be done with an image system that permits viewing the bubbles from the top.

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