Buoyancy driven small drops or air bubbles colliding with fluid-fluid interfaces

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By combining microfluidic methods for producing drops or bubbles with sizes in the few hundred micron range with high-speed video microscopy, we have been able to perform systematic studies of the bouyoncy driven motion at low Reynolds numbers of small drops or air bubbles through simple or complex liquids, as well as their collision with quasi-planar fluid-fluid interfaces. Here we focus on the latter process, i.e., the approach to, and collision with, the interface.

As a particular example, we will discuss a potentially new method for determining tight lower and upper bounds for the electrical potential of certain fluid-fluid interfaces. The value of the electric potential (or that of the closely related "zeta"-potential [1]) of a liquid-fluid (i.e., liquid or gas) interface is a crucial parameter for, e.g., the stability of emulsions which are extensively used in the food, cosmetics, or pharmaceutical industries [2]. Because such interfaces are deformable, determining their zeta-potential remains a challenging task [2].

We exploit the spontaneously occurring cascade partial coalescence [3] of a drop of heptol (toluene - n-heptane mixture) rising through water (electrolyte) with a water (electrolyte) - heptol quasi-planar interface, process in which a stable drop emerges as the final state, to estimate lower- and upper-bounds (calculated within the classic DLVO theory [1]) for the absolute value of the electric potential of the oil - water (electrolyte) interface.

References

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