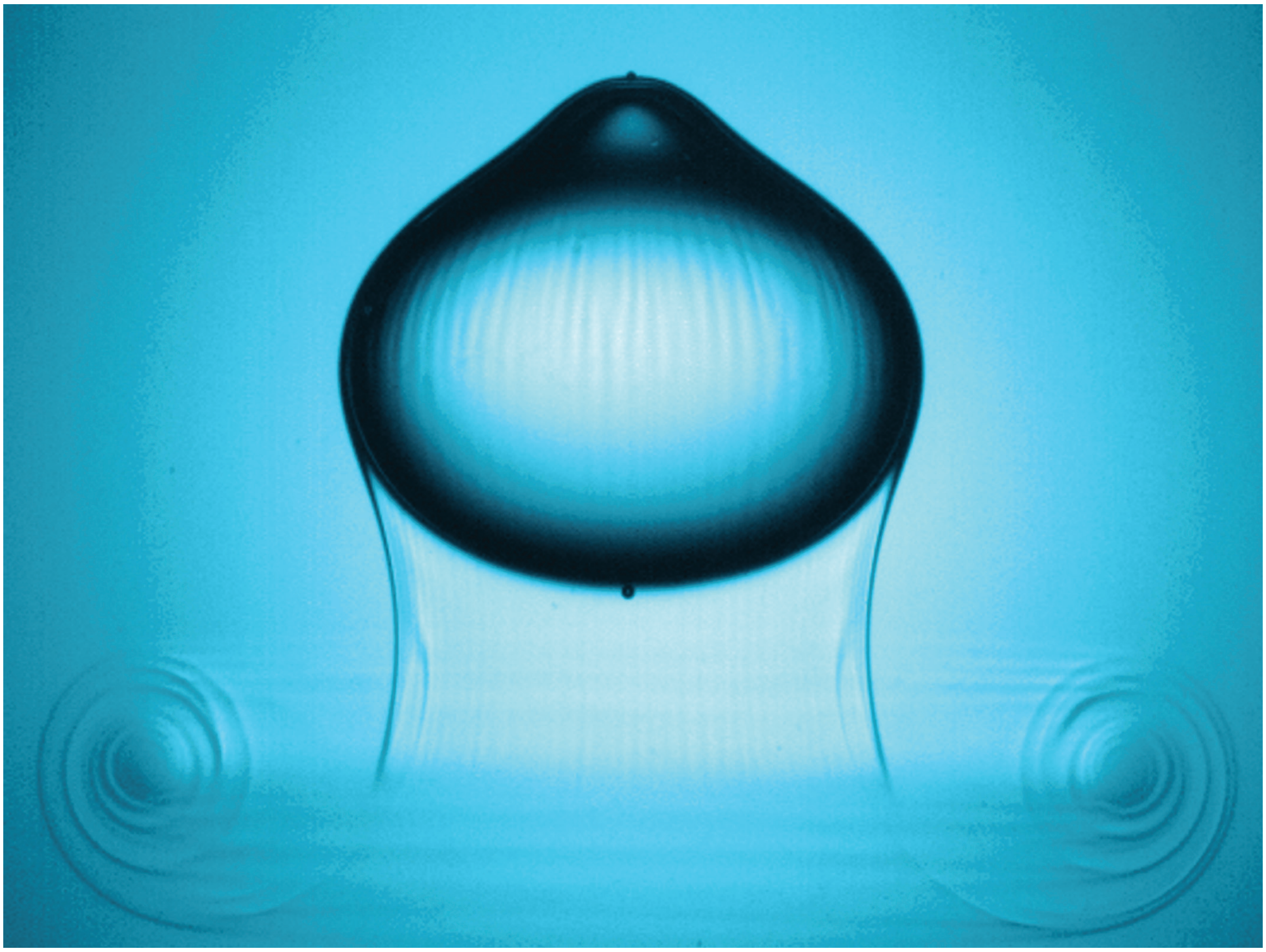

FIG. 1. (Color) Liquid core capsule having a thin hydrogel membrane (enhanced online) [URL: http://dx.doi.org/10.1063/1.3640013.1].

Liquid pearls

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(Received 21 July 2011; published online 30 September 2011)
[doi:10.1063/1.3640013]

Liquid pearls designate liquid core capsules having a thin elastic shell. Here, we describe the formation of millimetric liquid pearls with a hydrogel alginate membrane having a thickness of a few tens of micrometers.[1] These pearls can contain almost all type of liquids from pure water to oil. First, a compound drop is formed by the co-extrusion of a liquid core surrounded by an alginate solution in a dripping regime. Then, the compound drop is falling into an aqueous bath that contains calcium ions used for turning the alginate layer into a hydrogel shell. Since the outer layer of the compound drop can potentially mix with the surrounding miscible liquids, the formation of such structure is not as straightforward. During the impact, the mixing is initiated by the velocity contrast between the bath and the drop. The shear-induced instability is suppressed by inducing a surfactant precipitation at the drop interface that surprisingly becomes a transient elastic membrane. This allows the persistence of the thin surrounding alginate layer until gelling takes place. The compound drop is deformed during the penetration into the calcium bath. The gelling of the shell then occurs when the drop surface is not minimal. Thus, the surface buckles when the capsule is relaxing to a more rounded shape and leaves regular wrinkles on the shell (Fig. 1). The capsule sphericity, that is linked to the deformation amplitude at impact, is shown to be controlled by the core viscosity. Finally, cells can be encapsulated in these liquid pearls where transport of chemical species through the hydrogel membrane, from or to the surrounding medium, is possible. This opens the possibility to use such structure as a new tool for screening microorganisms or cell tissue growth in various three dimensional environments.

[1]N. Bremond, E. Santanach-Carreras, L. Y. Chu, and J. Bibette, "Formation of liquid-core capsules having a thin hydrogel membrane: liquid pearls," Soft Matter **6**, 2484 (2010).

