Wrinkling and folding on soft microcapsules

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Deformable particles such as cells, vesicles and microcapsules, have rich spatiotemporal dynamics of their shapes under flow. A striking example is the red blood cells (RBCs) in the shear flow : tumbling, swinging oscillations of the shapes.

Other non-linear phenomena, for example buckling, are observed on the stiffened RBCs [1,2]. Inspired by RBCs, we investigate emergence of such elastic instability on biomimetic microcapsules [3]. We found wrinkles and folds on deformed capsules under extensional flow.

Well-defined wrinkles are first observed on the membrane of stretched capsules when the deformation is above a critical deformation. However, further stretching, strongly non-linear phenomenon appears by localizing undulations, which is called folding. The origin and development of membrane instability were directly visualized by two views in our experiment. By combining the contribution of flow constraint and membrane elasticity, a phase diagram is thus obtained to predict the pattern formation on capsules [4]. In the near-threshold region, wavelength of wrinkles is found $\lambda_w \sim h^{1/2}$, where h is the thickness of membrane, in agreement with a theoretical prediction on thin sheets [5].

Références

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