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Selective breakup of lipid vesicles under acoustic microstreaming flow[1] ANGELO POMMELLA, VALERIA GARBIN, Imperial College London — The dynamics of lipid vesicles under small deformation in simple shear flow is well characterized: complex behaviors such as tumbling, breathing, and tank-treading are observed depending on the viscosity contrast between inner and outer fluid, vesicle excess area, membrane viscosity, and bending modulus. In contrast, phenomena upon large deformation are still poorly understood, in particular vesicle breakup. Simple shear flow geometries do not allow to reach the large stresses necessary to cause vesicle breakup. We use the acoustic microstreaming flow generated by an oscillating microbubble to study the large deformation and breakup of giant unilamellar vesicles. The deformation is governed by a capillary number based on the membrane elasticity K: $Ca = \eta\dot{\gamma}a/K$ where η is the viscosity of the outer fluid, a the vesicle radius, and $\dot{\gamma}$ the shear rate. We explore the effect of the mechanical properties of the membrane, and demonstrated selective breakup of vesicles based on the difference in membrane elasticity. The results reveal the influence of membrane mechanical properties in shear-induced vesicle breakup and the possibility to control in a quantitative way the selectivity of the process, with potential applications in biomedical technologies.

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