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Electrohydrodynamics of bilayer membranes[1] PAUL SALIPANTE, Brown University, RUMIANA DIMOVA, Max-Planck Institute of Colloids and Interfaces, PETIA VLAHOVSKA, Brown University — Membranes that encapsulate cells and internal cellular organelles are composed primarily of lipid bilayers. Biomimetic membranes assembled from polymers are used as vectors for targeted drug delivery. We investigate the deformation and stability of fluid membranes made of lipids or polymers in uniform electric fields. A frequency dependent shape deformation of vesicles (closed membranes) in AC fields elucidates the capacitive nature of the membrane and provides a new experimental method for measuring membrane capacitance. Compared to lipid membranes, we find that polymer membranes have an order of magnitude lower capacitance, which correlates with their larger thickness. Upon application of the electric field, the dynamic response of the vesicle is sensitive to membrane viscosity, while the steady state shape is governed by membrane tension and bending stiffness. Strong DC pulses, typically used in cell electroporation, is shown to induce an instability in both lipid and polymer membranes. The instability leads to vesicle collapse, where the timescale of collapse shows a $t \sim 1/E^2$ dependence.

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