Society of Engineering Science 51st Annual Technical Meeting

1–3 October 2014

Purdue University, West Lafayette, Indiana, USA

Electric-field-driven deformation, poration, and phase separation in biomimetic membranes

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ABSTRACT

When exposed to a DC electric pulse, giant vesicles made of bilayer membranes adopt peculiar drum-like shapes and may collapse. We present experimental results and theoretical model suggesting that the edge separates porated (conducting) and intact (insulating) regions of the membrane. The time dependence of the edge location can serve as a quick method to estimate the critical voltage for membrane poration. Electrohydrodynamic analysis of the deformation and collapse dynamics provides a novel means to measure the membrane viscosity. In the case of multicomponent membranes, the miscibility temperature (at which domains form in an initially homogeneous membrane) decreases with applied electric field strength.