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Relaxation of deformed drops, vesicles, and cells MIAO YU, JIA ZHANG, HAO LIN, Mechanical and Aerospace Engineering Department, Rutgers University, JEFFREY ZAHN, Biomedical Engineering Department, Rutgers University, WENCHANG TAN, Department of Mechanics and Engineering Sciences, Peking University — The deformation of drops, vesicles, and cells constitutes an important class of problems in chemical and biomedical engineering, and is often explored as a means to study interfacial dynamics and mechanical properties of the lipid membrane. Less attention has been paid to the relaxation process after the deforming mechanism is removed. In this work, analyses of such process are presented. A drop, vesicle or cell of spherical shape at rest is initially deformed into a spheroid. The relaxation process is then solved within the same theoretical framework in both small- and moderate-deformation limits. Different regimes are discovered. For sufficiently small initial deformations, the change in the membrane tension is a negligible higher-order effect for both vesicles and cells, and they behave identically to drops in the relaxation process. For moderate initial deformations, vesicle and cell relaxation is dominantly governed by the folding of undulations on the lipid membrane which differs from the behavior of a drop. Membrane properties, namely, membrane tension and bending rigidity, are the key parameters governing this dynamic process. A detailed comparison with experimental data for vesicles/cells is performed, and the results are presented and discussed.

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