Supplementary Information for
"Bulging and budding of lipid droplets from symmetric and asymmetric membranes: Competition between membrane elastic energy and interfacial energy"

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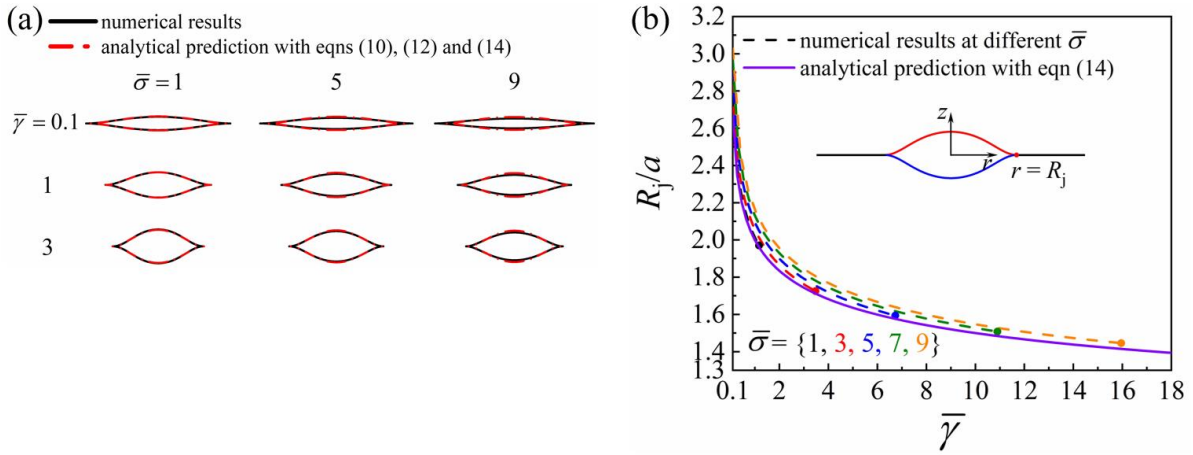

Fig. S1 Comparison between our numerical results using optimization and analytical prediction at $c_0=1/a$. (a) Selected shapes of contact regions, and (b) r-coordinate R_j of the triple junction.

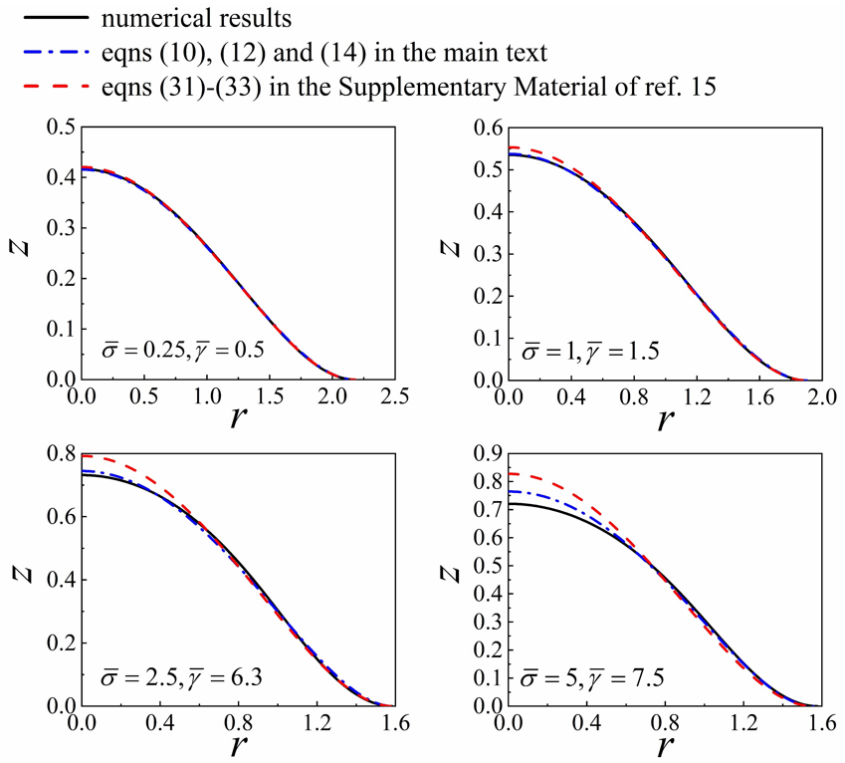

Fig. S2 Bulging profiles in the cases of two identical monolayers at $c_0=0$. Comparing the present fully nonlinear numerical results (black lines) and small deformation based analytical solutions (blue dash-dotted lines) with another small deformation based analytical predictions (red dashed lines) in the Supplementary Material of ref. 15. The small deformation assumption adopted in ref. 15 has been used in characterizing the membrane geometry as well as the membrane forces and their balance but in an inconsistent way.

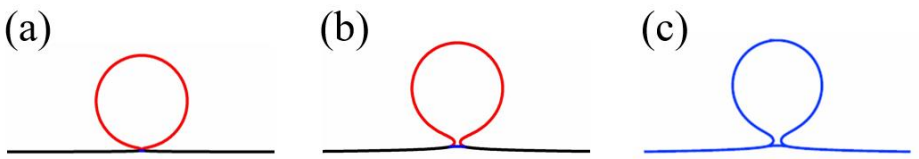

Fig. S3 System configurations in the budding state for two identical monolayers at $\bar{\sigma}=0$, $\bar{\gamma}=3.4$, and c_0=0. Numerical results based on the energy optimization with dense meshing (a) and loose meshing (b) in the vicinity of the highly curved neck regions. (c) The system configuration from Supplementary Material of ref. 15. The configuration (a) with dense meshing has a slightly lower energy of E_{tot}/κ=46.495 in comparison with E_{tot}/κ=46.636 for the configuration (b) mimicking reported configuration (c). It is indicated that the system configuration with a relatively large neck reported in ref. 15 might have a higher system energy than that with an extremely narrow neck, and the discrepancy suggests that a more appropriate initial guess is required for the shooting method in ref. 15.

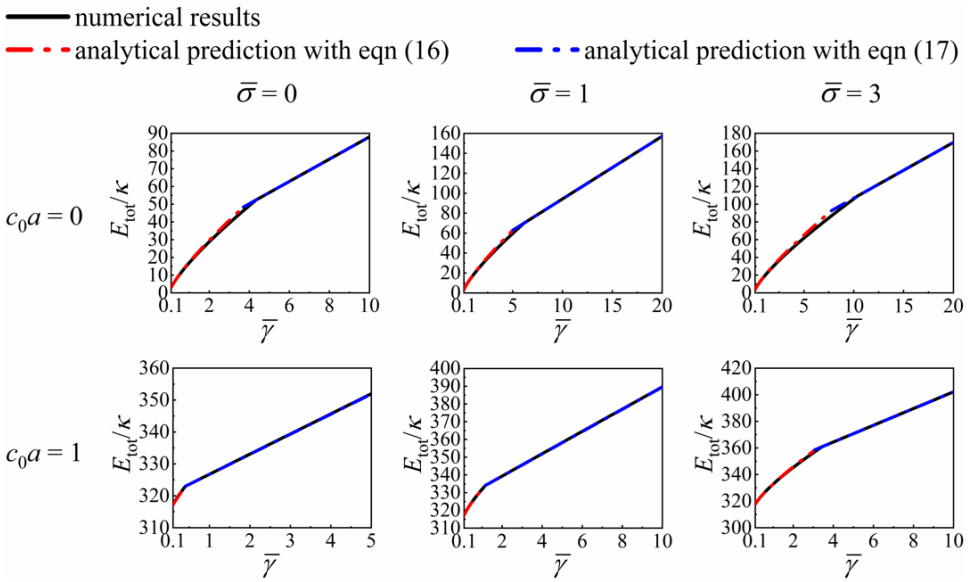

Fig. S4 Comparison of the total system energy E_{tot} between fully nonlinear numerical results and theoretical predictions given by eqn (16) and eqn (17) in the main text. The kinks in curves represent the critical values of $\bar{\gamma}$ associated with the budding transition.

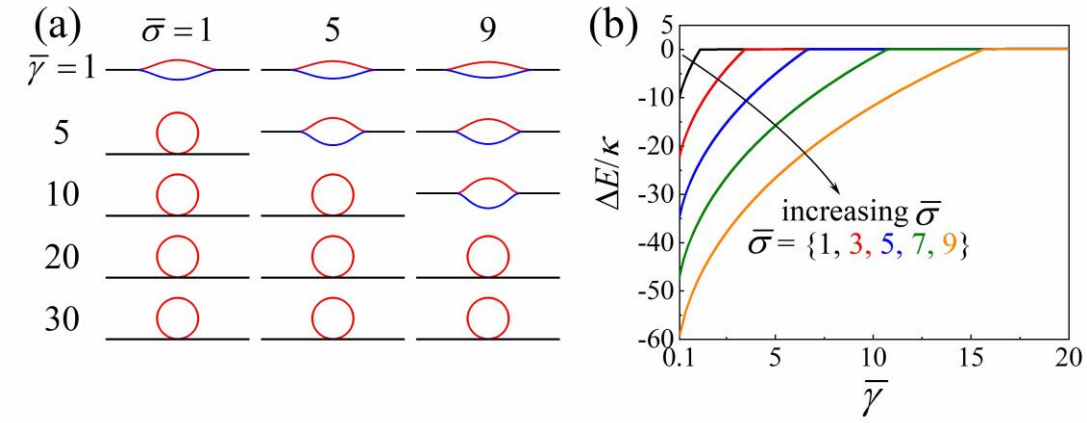

Fig. S5 Evolution of lipid droplet configurations and total energy change for the case of two identical monolayers with c_0=1/a. (a) Selected lipid droplet configurations at different sets of $(\bar{\sigma},\bar{\gamma})$. (b) Energy change ΔE as a function of $\bar{\gamma}$.

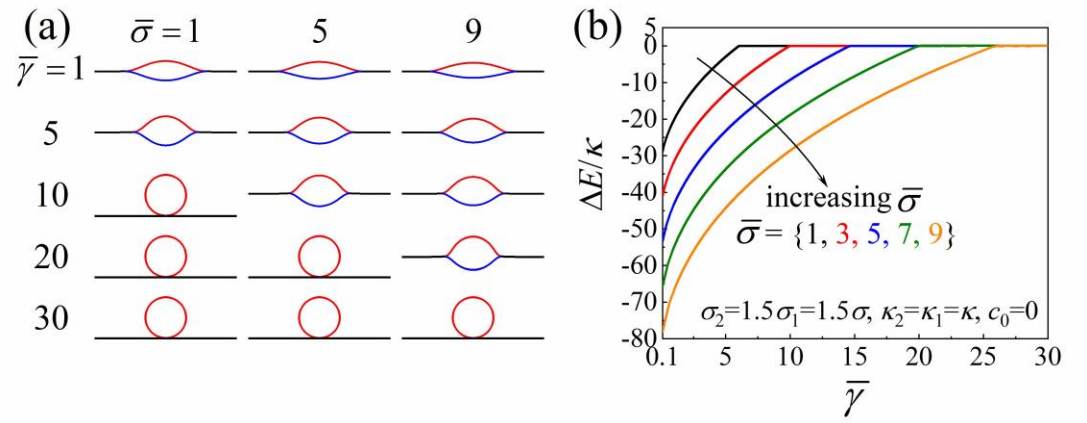

Fig. S6 Evolution of the system configurations and total energy change for a lipid droplet between two monolayers of different mechanical properties of σ_2=1.5σ_1=1.5σ, κ_2=κ_1=κ, and c_0=0. (a) Selected system configurations at different sets of $(\bar{\sigma},\bar{\gamma})$. (b) Profiles of the energy change ΔE.