Electronic Supplementary Material (ESI) for Soft Matter.

Supporting Information

Rheological study of nanoemulsions with repulsive and attractive interdroplet interactions

Zahra Abbasian Chaleshtari [a] and Reza Foudazi [b*]

[a] *Department of Chemical and Materials Engineering, New Mexico State University, Las Cruces, NM, USA*

[b] *School of Sustainable Chemical, Biological and Materials Engineering, The University of Oklahoma, Norman, OK, USA*

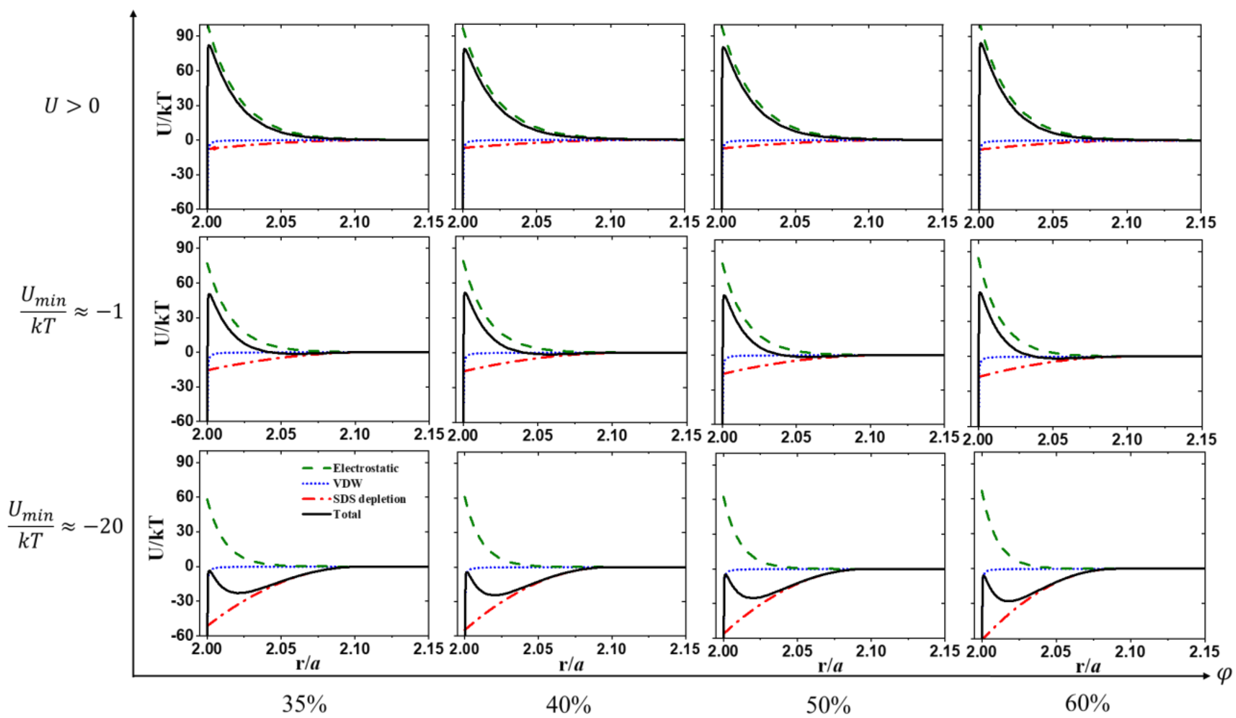

Figure S1. Contribution from SDS micelle depletion, VDW and electrostatic repulsion to the overall interaction potential of nanoemulsions with different dominant interactions over a volume fractions range.

[*] Corresponding author, email: rfoudazi@ou.edu.

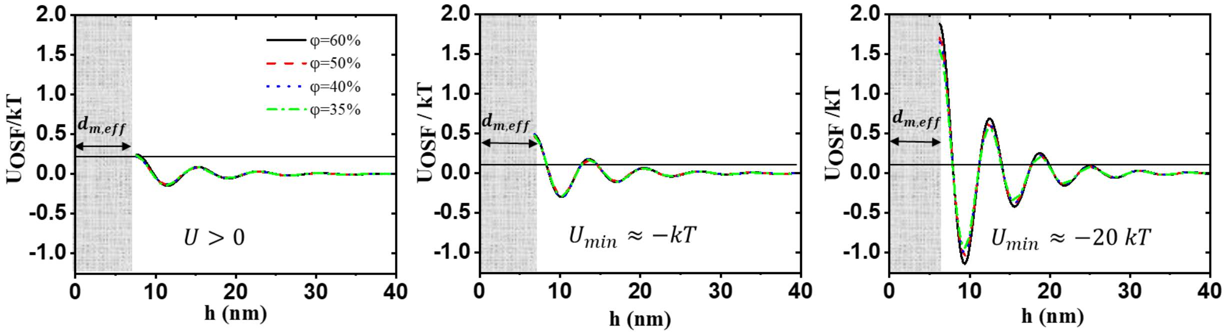

Figure S2. Oscillatory interaction energy for various oil volume fractions of nanoemulsions in three different regimes with $U > 0$, $U_{min} \sim -kT$, and $U_{min} \sim -20kT$ as a function of interdroplet distance h. The U_{OSF} is present in $h > d_{m,eff}$ and it is assumed that the patterned region is filled with one layer of micelles with effective diameter of $d_{m,eff}$. $d_{m,eff} = d_m + 2\kappa^{-1}$ where d_m is the SDS micelles diameter (≈ 4.8 nm).[1]

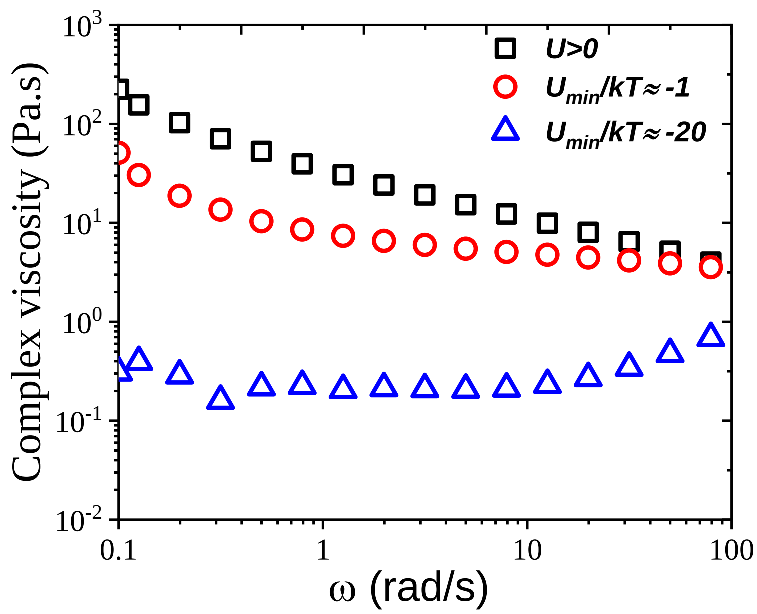

Figure S3. Complex viscosity of the nanoemulsions at $\varphi = 35\%$ as a function of frequency.

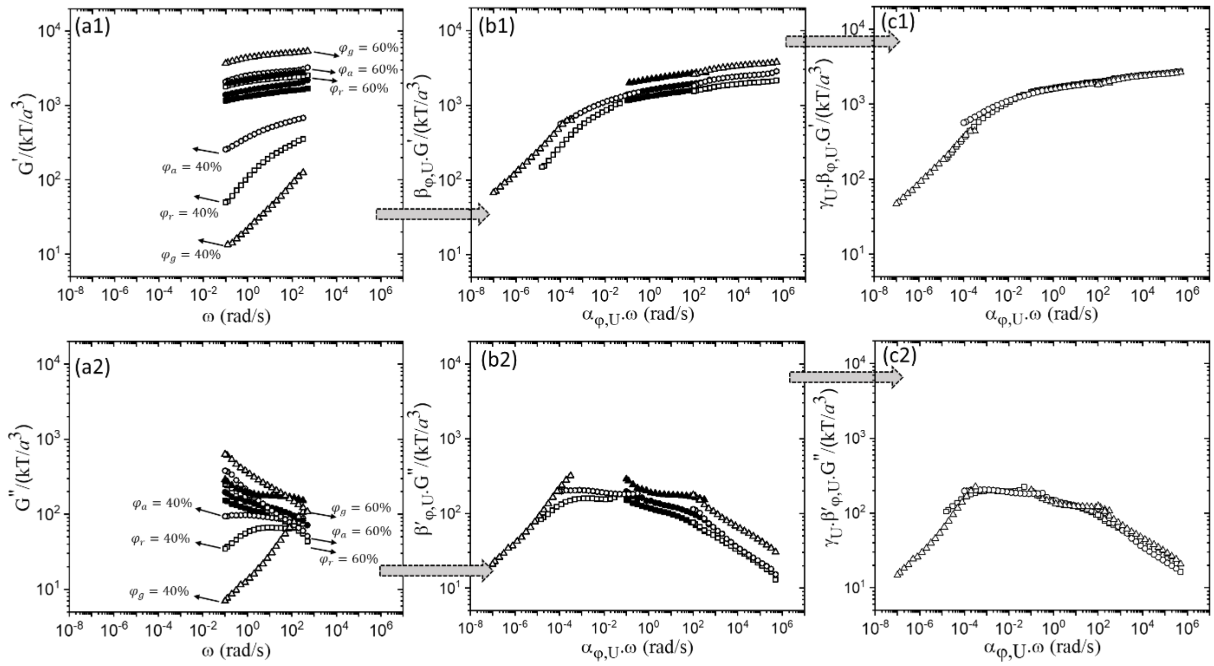

Figure S4. Different stages for constructing a master curve for storage and loss moduli of nanoemulsions with different interaction potentials and volume fractions in viscoelastic region: (a1-a2) Frequency dependence of scaled storage and loss moduli of the nanoemulsions with repulsive, weakly attractive and strongly attractive interactions and 40%-60% volume fraction. The subscripts of r, a, and g for φ stand for repulsive, weakly attractive, and strongly attractive regions (gel), respectfully. The filled symbols are at $\varphi = 50\%$*, which is considered as reference for superposition shifts. (b1-b2) Data points shifted horizontally with shift factor of* $\alpha_{\varphi,U}$ *(constant for both moduli) and vertically with shift factor* $\beta_{\varphi,U}$ *for storage modulus or* $\beta'_{\varphi,U}$ *for loss modulus. (c1-c2) The master curve for storage and loss modulus of nanoemulsions with different interaction potentials achieved by a second vertical transition with shift factor of* γ_U *which is constant for both moduli and is only a function of potential energy.*

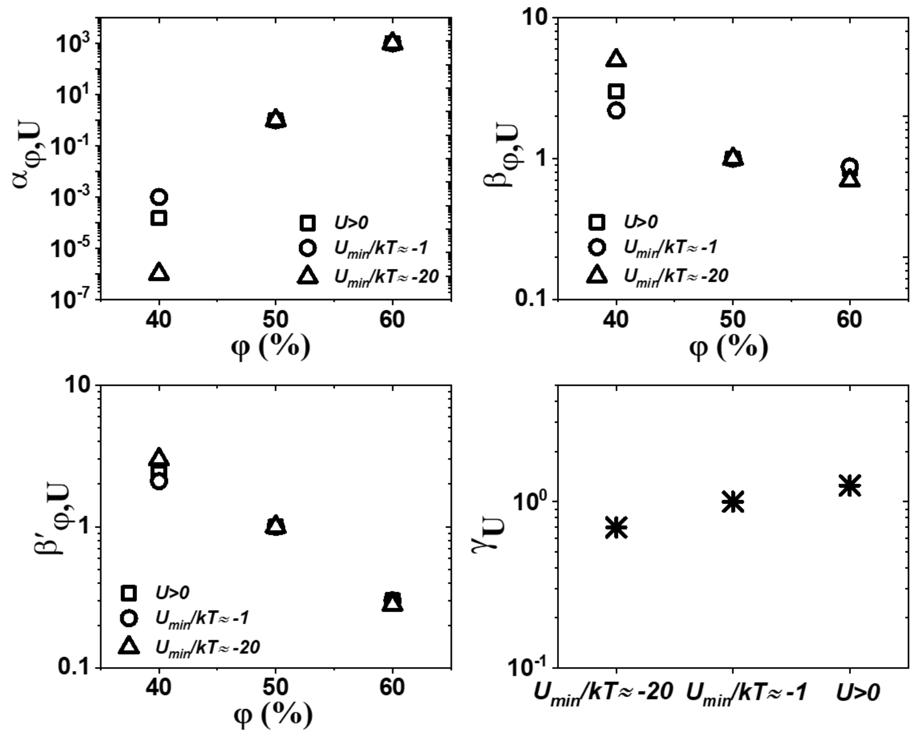

Figure S5. Shift factors for transition of storage and loss moduli of nanoemulsions and master curve construction.

References

(1) Petsev, D. N.; Denkov, N. D.; Kralchevsky, P. A. Flocculation of Deformable Emulsion Droplets. Ii. Interaction Energy. *J. Colloid Interface Sci.* **1995**, *176* (1), 201–213. https://doi.org/10.1006/jcis.1995.0023.