Influence of Interfacial Gas Enrichment on Controlled Coalescence of Oil Droplets in Water in Microfluidics

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SUPPORTING INFORMATION

The Hamaker-Lifshitz theory as described Eqs. (2) – (7) requires the full dielectric spectra of squalene[1] and water[2] to compute the Hamaker constant. We express the frequency of squalene and water dielectric spectra using the photon energy (eV) which is the frequency multiplied by the Planck constant ($2\pi\hbar$) as per the Planck-Einstein relation. Figure S1 shows the most recent spectra of squalene and water with possible extrapolations that are subject to the *f*-sum rule.

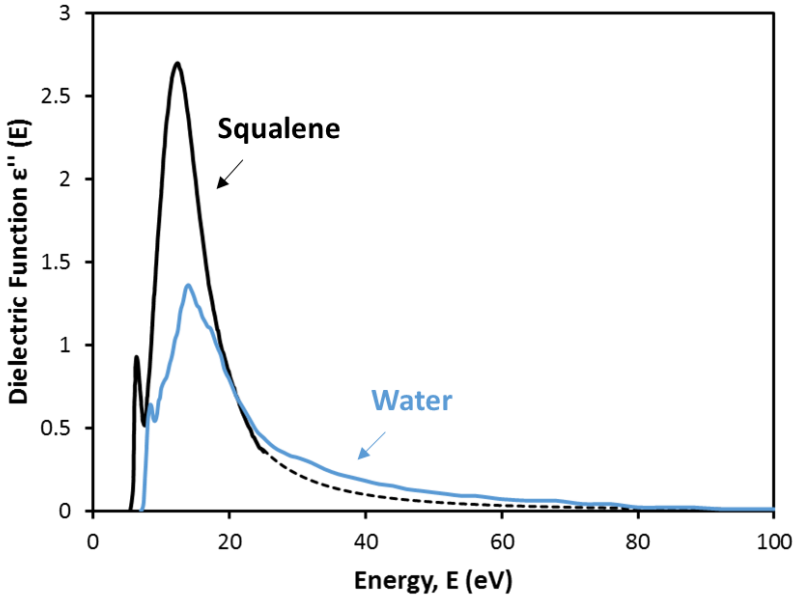

Figure S1. Dielectric spectra ε'' (solid lines) for squalene (black) and water (blue) with extrapolations: $\varepsilon''(E) = 3725.23E^{-2.86}$ for squalene (broken line) and $\varepsilon''(E) = 10705.08E^{-2.95}$ for water after 100 eV. Both extrapolations are subjected to the *f*-sum rule, i.e. $\int_0^\infty E\varepsilon''(E)dE = \frac{\pi}{2}E_P^2$, where E_P = 19.98 eV for squalene and E_P = 21.44 eV for water at 25°C.

$\varepsilon(i\omega)$ in Eqs. (2) - (7) is extracted from the imaginary part ε'' of dielectric function by a Kramers-Kronig relation[3] for the computation of van der Waals interactions:

$$\varepsilon(i\xi) = 1 + \frac{2}{\pi}\int_0^\infty \frac{x\varepsilon''(x)}{x^2+\xi^2}dx \qquad \text{(S1)}$$

where x is the integration dummy for the real frequency. Figure S2 shows the values of $\varepsilon(i\omega)$ calculated from ε'' versus index, n, of sampling frequency.

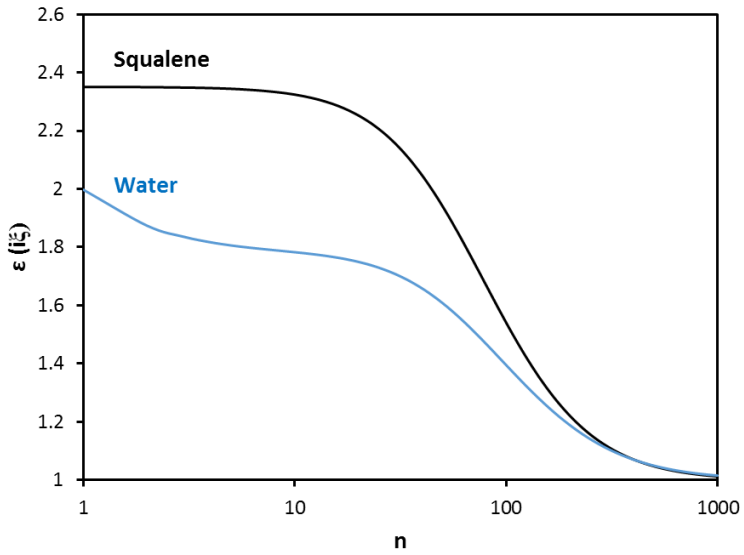

Figure S2. The values of $\varepsilon(i\omega)$ calculated from ε'' versus index, n, of sampling frequency. Dielectric constants are: $\varepsilon(0) = 2.35$ for squalene and $\varepsilon(0) = 78.46$ for water.

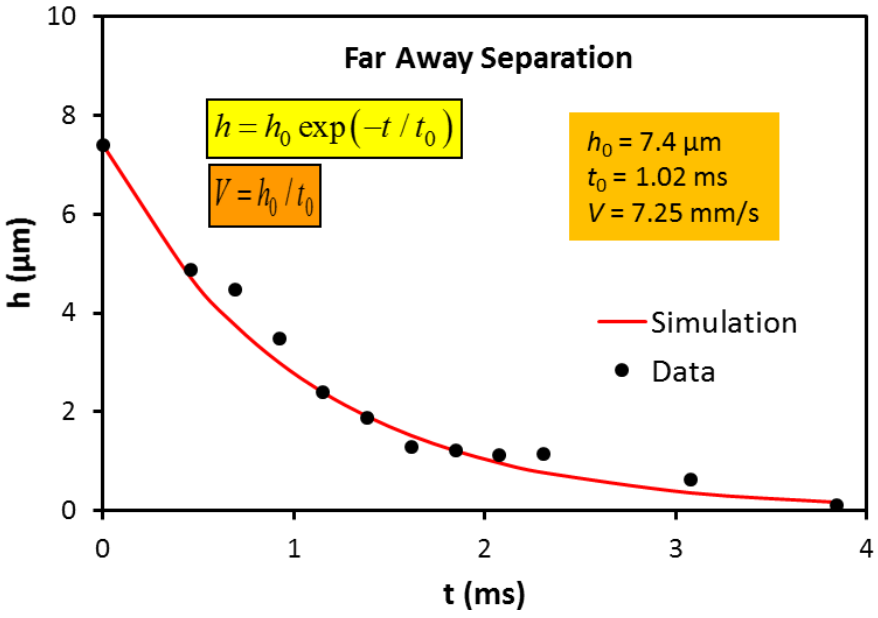

Figure S3. Determination of V and t_0 for the boundary condition of Eq. (10).

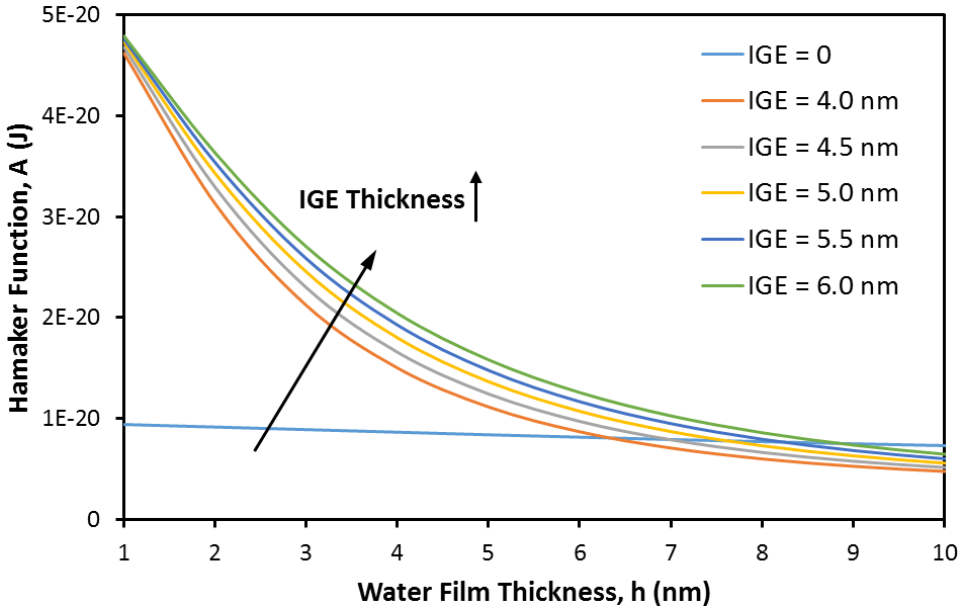

Figure S4. Increased Hamaker function with IGE thickness.

Reference

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2. Hayashi, H.; Hiraoka, N., Accurate measurements of dielectric and optical functions of liquid water and liquid benzene in the VUV region (1–100 eV) using small-angle inelastic X-ray scattering. *The Journal of Physical Chemistry B* **2015,** *119* (17), 5609-5623.
3. Landau, L. D.; Lifshitz, E. M., Chapter IX - The Electromagnetic Wave Equations. In *Electrodynamics of Continuous Media (Second Edition Revised and Enlarged)*, Pergamon: Amsterdam, 1984; Vol. 8, pp 257-289.