Supplementary Information

Optically Probing Nanoemulsion Compositions

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Droplet Size Characterization

We use dynamic light scattering (DLS) at 90 degrees to measure the droplet radial size distributions of the 10 cSt PDMS/SDS/H_2O oil-in-water nanoemulsions used in our experiments. All nanoemulsions have been made according to the process described in the main text and are diluted in water to a volume fraction $\approx 10^{-5}$ for the DLS measurements. From the distributions, we extract average droplet radius $\langle a \rangle$ and polydispersity. As C varies between 25 mM and 800 mM, $\langle a \rangle$ ranges from 20 nm to 80 nm, as shown in Supplementary Figure 1. The polydispersity is approximately 0.3 for all samples. We find that over the range of ϕ we examine in this study, there is no significant variation in $\langle a \rangle$, as has been found previously (see ref. [2]).
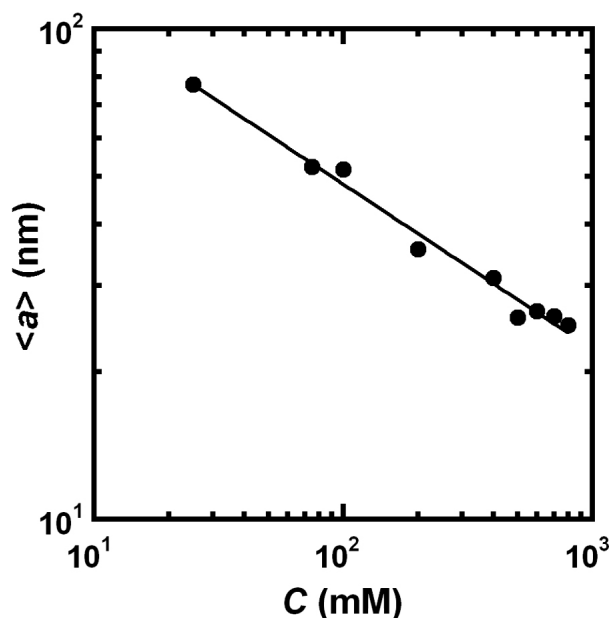
Supplementary Figure 1. For 10 cSt PDMS/SDS/H_2O oil-in-water nanoemulsions, $\langle a \rangle$ is plotted as a function of SDS surfactant concentration C; the droplet volume fraction is fixed at $\phi = 0.30$. The solid line is an empirical fit to $\langle a \rangle \sim C^{-1/3}$. All measurements have been performed at a temperature of $T = 21.0$ °C.

Normalized Refractive Index Difference: Insensitivity to Nanoscale Average Droplet Radius

We have measured the normalized refractive index difference χ as a function of $\langle a \rangle$ for 10 cSt PDMS/SDS/H_2O oil-in-water nanoemulsions having fixed $C = 100$ mM at several different ϕ, as shown in Supplementary Figure 2. We find that, for a given ϕ, χ is effectively independent of $\langle a \rangle$, provided $\langle a \rangle < 100$ nm. Thus, at a fixed surfactant concentration, if the nanodroplets are small enough compared to the wavelength of probe light, only their volume fraction, and not their size, influences χ significantly.
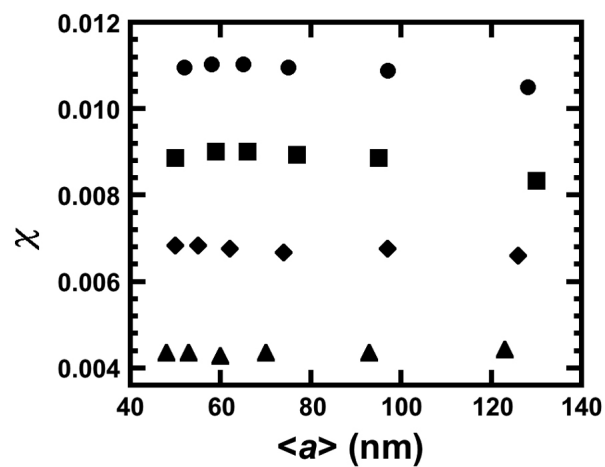
Supplementary Figure 2. For 10 cSt PDMS/SDS/H_2O oil-in-water nanoemulsions, the normalized refractive index difference χ is plotted against average droplet radius $<a>$ at fixed SDS surfactant concentration $C = 100$ mM for a series of different ϕ: 0.05 (▲), 0.1 (◆), 0.15 (■), and 0.2 (●). Provided $<a> < 100$ nm, there are only very small variations in the measured $\chi(<a>)$, so χ is insensitive to droplet size over the range we report in the main text. All measurements have been performed at a temperature of $T = 21.0$ °C.