Electronic Supplementary Material (ESI) for Soft Matter

Shear-Stability and Gelation of Inverse Latexes

Electronic Supplementary Information

Stefano Lazzari, Giovanni M. Maggioni, Miroslav Soos, Hua Wu*, Massimo Morbidelli*

Institute for Chemical and Bioengineering, Department of Chemistry and Applied Biosciences,

ETH Zurich, 8093 Zurich, Switzerland

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*Corresponding authors:

E-mail: hua.wu@chem.ethz.ch; massimo.morbidelli@chem.ethz.ch. Fax: +41 44 632 10 82

CFD simulations

For the present CFD analysis laminar flow conditions were applied and the system, composed of cup and stator, was divided in 3×10^6 mesh elements. The liquid volume considered was 1.5 ml to reproduce the experimental conditions employed, while a constant density of 1000 kg/m^3 and a constant viscosity of 0.15 Pa·s were chosen as representative measures of the Inverse Latex (IL) under investigation.

The results of the CFD analysis can be seen in Figure S1, where the shear rate profile on the stator surface can be seen. From Figure S1, as expected, the lowest shear rates are found in the center of the stator, while the highest are seen at its edges.

To properly quantify the values of the shear rate that the fluid undergoes in the different sections of the cup, we identify three zones (indent of Figure S2). The corresponding shear rate distributions can be observed in histogram form in Figure S2Figure S2. Notably, the distribution of shear rates is weighted on the volume fractions, where each distribution has been normalized on the volume of its own zone.

As expected, the highest shear rate is found in the bottom part of the rheometer (zone 3), while in zones 2 and 1 the shear rates become progressively lower, as the distance towards the wall increases. Interestingly, the overall average shear rate is only 581 s^{-1}, which is substantially smaller than the shear rate (2000 s^{-1}) of the standard geometries we used at which no gelation occurred (see previously discussed in Section 2.2). This means that the gelation typically observed in the IL is due to the maximum shear rate, which lies around 5600 s^{-1}.

The aforementioned CFD simulations have been performed to identify the real shear rate profiles in other two cases applied (IL 235 was sheared also at two other shear rates). These turned out to be 5100 s^{-1} and 6200 s^{-1}.

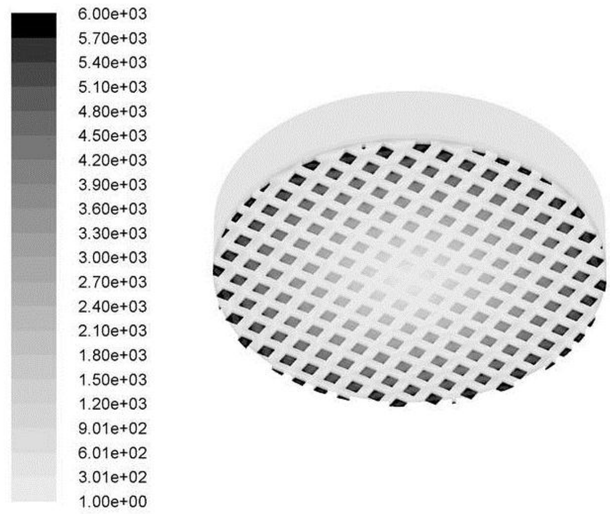

Figure S1

Contours of Shear Rate by CFD

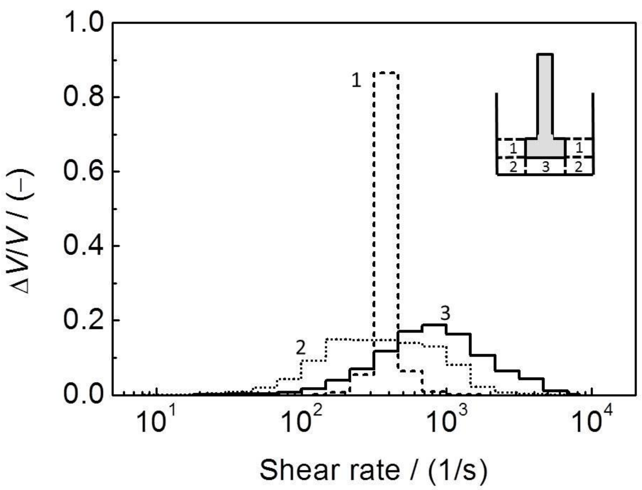

Figure S2

Shear rate distribution of the three different volume portions

Ostwald Ripening of surfactant E_1 in oil

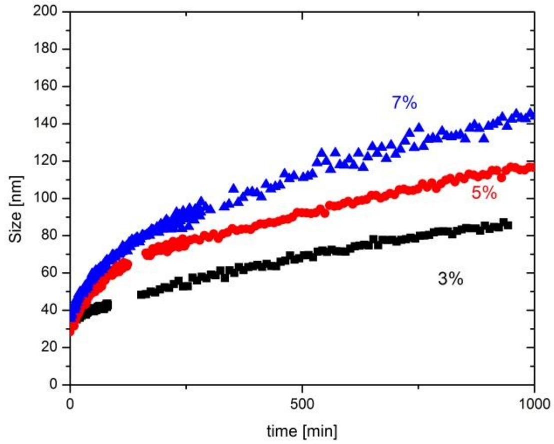

Figure S3

Emulsifier E_1 contains water impurities: upon solution of E_1 in oil, 30 nm water-swollen micelles are observed. These particles undergo Ostwald ripening in time, showing a size increase

Scaling of gelation time with shear rate

As mentioned in Subsection 3.2.2, IL 235 has been sheared at three different shear rates, and it is found that the gelation time decreases as the shear rate increases. In addition, the gelation time scales exponentially with the shear rate, as can be seen in Figure S3, where the gelation time, t_{gel} of IL 235, is plotted as a function of shear rate. The continuous line represents an exponential fit, with an $R^2 = 0.99$.

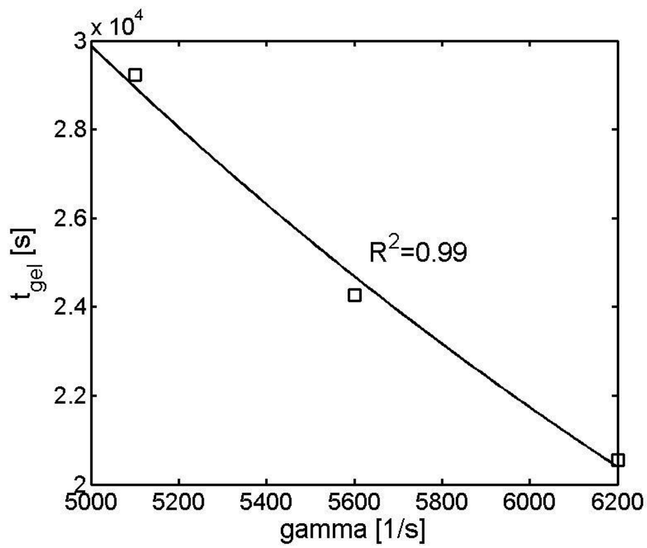

Figure S4

The t_{gel} values of IL 235 (squares) as a function of shear rate, gamma ($\dot{\gamma}$). The line represents an exponential fit in the form of $t_{gel} = Ae^{-\dot{\gamma}}$.