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Irreversible flow-induced vitrification of nanoemulsions by extreme droplet rupturing JAMES N. WILKING, Dept. of Chemistry, University of California- Los Angeles, THOMAS G. MASON, Depts. of Physics and Chemistry, University of California- Los Angeles — Some materials weaken through fracturing when subjected to extreme stresses. However, breaking down repulsive bits of condensed matter that are dispersed in a viscous liquid can also potentially cause a dramatic and irreversible increase in the dispersion's elasticity. Here, we demonstrate this principle using dispersions of one liquid in another immiscible liquid. Anionically stabilized microscale emulsions are subjected to a history of extreme high-pressure microfluidic flow, causing the droplets to rupture to nanoscale sizes. As the droplet radius decreases below 100 nm, the nanoemulsion can develop an unusually large elastic modulus, even at droplet volume fractions far below maximal random jamming of uniform hard spheres. Thus, through the history of applied flow, a liquid microscale emulsion can be transformed and vitrified into an elastic nanoemulsion of disordered repulsive droplets without altering the composition. Furthermore, we show that systematic macroscopic shear rheology of the nanoemulsion glass as a function of the droplet volume fraction can be effectively used as a surfaces forces apparatus to deduce the screened Debye interaction potential as a function of separation between the droplet interfaces.

Thomas Mason
University of California-Los Angeles

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