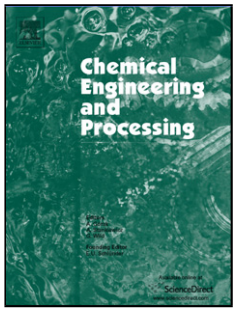

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Flow-switchable morphology of concentrated emulsions

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Soft materials can be switched from a liquid to a gel-like state by structural re-arrangement down to the nanoscale and find application in many fields ranging from biomedical engineering to oil recovery. Here, we show that flow-switchable emulsions of oil, water and surfactants can be obtained by simple low-energy emulsification processing. By dropwise addition of water to the oil-surfactant solution under mild stirring, a striking transition from a transparent, purely viscous Newtonian fluid to a highly viscoelastic translucent material climbing onto the impeller is observed. We show that this transition is associated with the formation of elongated droplets, eventually disrupting into nanodroplets which, upon stopping the flow, slowly relax to a stable gel-like microstructure with noticeable birefringent properties. The two structures (elongated droplets and gel-like microstructure) can be reversibly switched between each other by starting/stopping the flow. This behavior can be attributed to the interplay between the cluster-disruptive effect of flow on one side, and droplets attractive interactions promoting coalescence on the other side. Our results, observed for different systems by changing oil type and surfactants chain length, highlight a flow-switchable emulsions processing method, which can be used to produce concentrated emulsions for a variety of applications.

Keywords: flow-induced structuring, emulsions, birefringence, nanodroplets, attractive interactions