Abstract Submitted
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Particle and fluid transport during imbibition of strongly confined emulsions in parallel-wall channels.[1] MASOUD NOROUZI DARABAD, Dept. of Chemical engineering, Texas Tech University, SAGNIK SINGHA, JERZY BLAWZDZIEWICZ, Dept. of Mechanical engineering, Texas Tech University, SIVA A. VANAPALLI, MARK W. VAUGHN, Dept. of Chemical engineering, Texas Tech University — We investigate capillary imbibition of a monodisperse emulsion into a high-aspect ratio microfluidic channel with the height h comparable to the droplet diameter d. For the confinement ratio d/h = 1.2, the tightly confined droplets in the channel move more slowly compared to the average suspension velocity. Behind the meniscus that drives the imbibition there is a clear fluid region, separated from the suspension region by a sharp concentration front. The suspension exhibits strong density and particle velocity fluctuations, but on average the suspension domain remains uniform. For weaker confinement, d/h = 0.65, the drop phase moves faster than the average suspension flow, resulting in the formation of a dynamically unstable high-concentration region near the meniscus. We describe the macroscopic suspension dynamics using linear transport equations for the particle-phase flux and suspension flux that are driven by the local pressure gradient. A dipolar particle interaction model explains the observed large density and velocity fluctuations in terms of the dynamics of elongated particle clusters with different orientation.

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