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Single droplet-level understanding of flow-induced phase inversion of emulsions ANKIT KUMAR, Univ of Pennsylvania, SHIGENG LI, CHIEH-MIN CHENG, Xerox Corp., DAEYEON LEE, Univ of Pennsylvania — Phase inversion emulsification (PIE) is a process of generating emulsions by inverting the continuous and dispersed phases of a pre-existing emulsion. It is particularly useful when it is challenging to generate the target emulsions by conventional emulsification methods. Phase inversion of emulsions by flowing them through precisely engineered conduits is called flow-induced phase inversion emulsification (FIPIE). In this study a fundamental understanding of the underlying mechanism of FIPIE is developed. Phase inversion of monodisperse oil-in-water (O/W) emulsions into water-in-oil (W/O) emulsions is achieved by flowing them through specifically designed microfluidic channels. Based on in situ observation of single droplet-level events which lead to phase inversion, a mechanism of the process has been proposed. The outcome of the process is shown to depend on two dimensionless groups - Capillary number (relative importance of viscous and surface tension effects) and dimensionless droplet deformation (D/w , ratio of droplet size to channel width). It can be concluded from a state-plot between Ca and D/w that lower Ca and higher (D/w) facilitate FIPIE.

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