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Microscopic reversibility and memory in soft crystals undergoing large deformations LIAT ROSENFELD, Stanford University, CLAUDIU STAN, SLAC National Accelerator Laboratory, SINDY K.Y. TANG, Stanford University — In this study, we explore the transition from reversible to chaotic behavior in an oscillatory shear flow of water-in-oil emulsions. The emulsion was injected through a microchannel and was forced to rearrange due to a central constriction in the channel. We study the motion of the individual droplets and their neighbors in order to determine their ability to retain their original position after several cycles of oscillations. We have found that the emulsion exhibit behaviors that vary from complete reversibility to complete irreversibility depending on the volume fraction, velocity and strain rate. The reversibility, both in the trajectory and the deformation of every drop, is reproducible even when the drops undergo many rearrangement events over distances of >150 droplet diameters. Moreover, the deformability of the drops and the high volume fraction are crucial conditions for the onset of reversibility. We provide here the first direct visualization and physical analysis of this phenomenon. This work is an important step in describing the flow of concentrated emulsions and suspensions in microchannels and is therefore crucial for understanding the behavior of droplets, bubbles and particles in droplet microfluidic applications.

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