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On an ordered flow of a two-dimensional concentrated emulsion confined in a tapered microchannel YA GAI, Aeronautics and Astronautics, Stanford University, CHIA MIN LEONG, Mechanical Aerospace and Nuclear Engineering, Rensselaer Polytechnic Institute, WEI CAI, SINDY K. Y. TANG, Mechanical Engineering, Stanford University — We report an unexpected order in a monolayer flow of concentrated emulsion in a tapered microchannel. The flow of droplets in confined geometry can be non-trivial, giving rise chaos and long-period oscillations. Previously, there have been studies on concentrated emulsions in straight and bended channels. The dynamics of how a concentrated emulsion flow, especially the interactions among droplets, has not yet been characterized in a tapered geometry. Our results show at sufficiently low flow rates, while the time-averaged droplet velocities are uniform, the instantaneous drop velocities exhibit a wave-like periodicity. A close examination reveals this anomalous velocity profile arises from a sequence of rearrangement events that are both spatially and temporally periodic. We show these ordered rearrangement events can be modeled by the slipping motion of dislocations in crystal plasticity. In addition, we characterize the timescale associated with these rearrangements and identify parameters that affect this timescale. To our best knowledge, such ordered flow in a confined concentrated emulsion has not been studied before. Our results are useful in droplet-based flow control and mixing strategies as well as modeling crystal plasticity in low-dimensional nanomaterials.

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