Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Periodic dislocation dynamics in two-dimensional concentrated emulsion flowing 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 — Here we report a surprising order in concentrated emulsion when flowing as a monolayer in a tapered microfluidic channel. The flow of droplets in micro-channels can be non-trivial, and may lead to unexpected phenomena such as long-period oscillations and chaos. Previously, there have been studies on concentrated emulsions in straight channels and channels with bends. The dynamics of how drops flow and rearrange in a tapered geometry has not yet been characterized. At sufficiently slow flow rates, the drops arrange into a hexagonal lattice. At a given x-position, the time-averaged droplet velocities are uniform. The instantaneous drop velocities, however, reveal a different, wave-like pattern. Within the rearrangement zone where the number of rows of drops decreases from N to N-1, there is always a drop moved faster than the others. Close examination reveals the anomalous velocity profile arises from a series of dislocations that are both spatial and temporal periodic. To our knowledge, such reproducible dislocation motion has not been reported before. Our results are useful in novel flow control and mixing strategies in droplet microfluidics as well as modeling crystal plasticity in low-dimensional nanomaterials.

Ya Gai
Stanford Univ

Date submitted: 29 Jul 2016 Electronic form version 1.4