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Synchronizing the droplet breakup in a microfluidic channel[1]
EUJIN UM, MINJUN KIM, Ulsan National Institute of Science and Technology (UNIST), HYOUNGSOO KIM, Korea Advanced Institute of Science and Technology (KAIST), HOWARD STONE, Princeton University, JOONWOO JEONG, Ulsan National Institute of Science and Technology (UNIST) — Synchronization phenomena are ubiquitous, such as flickering fireflies or pendula of nearby clocks. While the mechanism of synchronization in many examples is difficult to understand, we propose that oscillating oil/water interfaces in a microfluidics channel can be a simple experimental model system of hydrodynamic synchronization. In a double T-junction design of the microchannel, the aqueous phase is injected from the two opposite branches into the middle channel filled with the flowing oil phase. By changing parameters such as the flow rates and the distance between the interfaces, we identify various regimes of droplet breakup including the in-phase synchronization, where two aqueous phases protrude simultaneously from the branches, leading to the simultaneous droplet breakup from two interfaces. To elucidate our experimental observations of the emergence of the in-phase synchronization, we introduce a numerical model of droplet breakup, considering the changes in pressure between the interfaces and within the droplets as the hydrodynamic coupling factor.

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Eujin Um
Ulsan National Institute of Science and Technology (UNIST)

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