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Magnetophoretic control of water droplets in bulk ferrofluid GEORGIOS KATSIKIS, Stanford University, ALEXANDRE BRANT, Ecole Polytechnique, Paris-Saclay, MANU PRAKASH, Stanford University — We present a microfluidic platform for 2-D manipulation of water droplets immersed in bulk oil-based ferrofluid. Although non-magnetic, the droplets are exclusively controlled by magnetic fields, without any pressure-driven flow. The diphasic fluid layer is trapped in a submillimeter Hele-Shaw chamber that includes permalloy tracks on its substrate. An in-plane rotating magnetic field magnetizes the permalloy tracks, thus producing local magnetic gradients, while an orthogonal magnetic field magnetizes the bulk ferrofluid. To minimize the magnetostatic energy of the system, droplets are attracted towards the locations of the tracks where ferrofluid is repelled. Using this technique, we demonstrate synchronous propagation of water droplets, analyze PIV data of the bulk ferrofluid flow and study the kinematics of propagation. In addition, we show droplet break-up, merging and derive relevant scaling laws. Finally, we discuss future applications owing to the biocompatibility of the droplets.

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