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Numerical and Experimental Observation of Chaotic Mixing in Microfluidic Mixer

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Fig. 1. Schematic of the chaotic mixer structure. Model A (left) and B (right).

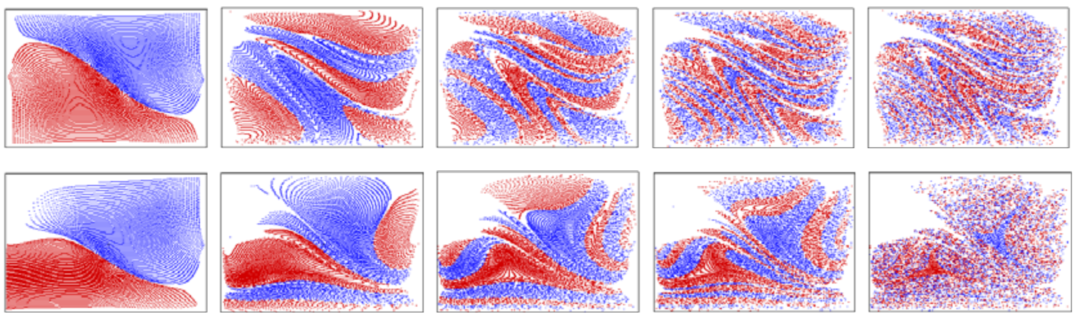

Fig. 2. Inert particle mixing at section A (as indicated in Fig. 1). (top) Model A, Re = 0.02, the first 5 cycles; (bottom) Model B, Re = 0.2, the first 4 cycles and the 10^{th} cycle.

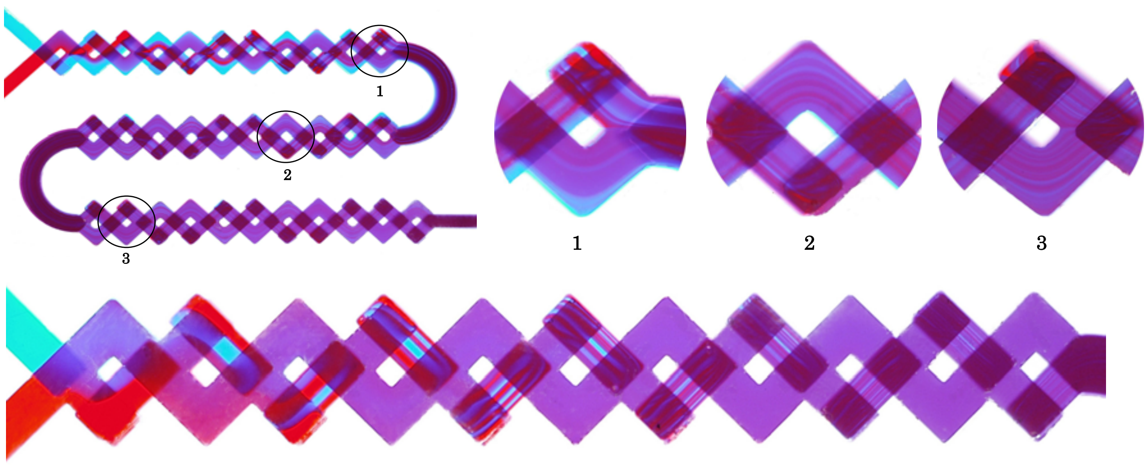

Fig. 3. Experimental mixing pictures with scaled-up model A (top) and model B (bottom) at Re = 0.01. The fluid is highly viscous 98% glycerol-2% liquid food dye (red and blue) solution.

Both the chaotic mixers (Fig. 1) adopt a two-layer overlapping channels structure, which is very efficient for fluid manipulations such as stretching and folding, splitting and recombination. Even at extremely low Re ($\sim 10^{-2}$), chaotic advection can be generated.

Both particle tracing simulation (Fig. 2) and experimental results (Fig. 3) show that as the fluids are driven through the mixer, striations occur resulting in large interface area to promote diffusive mixing.