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Laminar mixing via steady streaming Using an active ionic polymer actuators[1] C. CLAWSON, A. WILLIAMS, M. PAUL, P. VLACHOS, Virginia Tech — Low Reynolds number and microscale mixing has been garnering significant attention in recent years due to the demands of developing microfludics. In this work we develop a novel active micro-mixer in a two-dimensional closed chamber with one active wall. This "active skin" is a flexible surface composed of an ionic active polymer transducer that deflects on the order of microns under an applied voltage potential. The effectiveness of the ionic polymer over a range of frequencies and actuation amplitudes was explored under an initially quiescent flow. Time Resolved Digital Particle Image Velocimetry (TRDPIV) was employed to resolve the resulting flow structures. The principle of operation of this mixing device is based on capitalizing on steady streaming effects. Bodies oscillating with the appropriate frequency and amplitude produce steady streaming. Steady streaming occurs when nonlinearities within the viscous boundary layer rectify the oscillatory flow and cause a steady, time-averaged flow outside the boundary layer. Orders of magnitude analysis shows a significant improvement over diffusion alone. This research indicates that laminar mixing can be greatly enhanced by steady streaming, thus exploiting a new avenue for the development of future micro-mixing devices.

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