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Effect of chaos on transport to reactive boundaries from 3D flows in microfluidic systems JOSEPH D. KIRTLAND, ABRAHAM D. STROOCK, Cornell University — Microfluidic systems are generally characterized by laminar, uniaxial flow and slow, purely diffusive mixing in the cross section, resulting in poor bulk mixing and limited mass transfer to reactive boundaries. It is known that the introduction of chaotic particle trajectories and large chaotic invariant sets results in improved mixing in the bulk, but the effect of chaos on transfer to boundaries is not well documented. We study three dimensional flows produced by grooves patterned along one or more of the microchannel walls, as in the Staggered Herringbone Mixer (SHM). Mass transfer to reactive boundaries can be substantially increased by the introduction of these 3D flows, and chaos can be crucial in ensuring sustained increases in mass transfer at high flow rates and large axial distances. We will present numerical and experimental results that demonstrate the requirements for producing this desirable behavior in terms of the chaotic characteristics of the flow and the connection of the principal chaotic invariant set to the reactive boundary.

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