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**On the optimization of mixing for shear-sensitive materials** OLEG GUBANOV, LUCA CORTELEZZI, McGill University — Microfluidic mixing could have a major impact on medical applications involving the treatment of biological fluids. In these applications, high shear stresses induced by mixing can damage shear-sensitive components such as red blood cells, DNA or microbial cultivations. Further damages can be produced by mixing over long periods of time or by turbulence. Hence, these applications require a mixing device able to induce a desired level of homogeneity in the shortest time possible for a given value of energy while maintaining shear stresses below a given threshold. In this study, we address the conceptual challenge of designing such a device by studying the optimization of mixing in an idealized advective-diffusive model derived from the sine flow. In our model, a concentration field is stirred iteratively by blinking orthogonal velocity fields whose profiles, represented by a truncated Fourier series, are optimized at each blinking time. These velocity profiles are the solution of a constrained optimization problem which maximizes the efficiency of the mixer for a given value of the operating kinetic energy while satisfying a shear stress constraint. We establish the domain of operability of the mixer and quantify its mixing efficiency for a range of values of the operating kinetic energy and shear stress. We show that for a given kinetic energy the optimized flow can be substantially more mixing efficient than the periodic sine flow while satisfying the shear stress constraint.

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