

Abstract Submitted
for the DFD08 Meeting of
The American Physical Society

Micro-fluidic Mixing using Artificial Cilia MICHEL BALTUSSEN, Technische Universiteit Eindhoven, JAAP DEN TOONDER, Technische Universiteit Eindhoven / Philips Research Laboratories, FEMKE BOS, PATRICK ANDERSON, Technische Universiteit Eindhoven — The unexpectedly high mixing efficiency of our previously developed micro-mixer [1] is investigated. This mixer uses polymer actuators mimicking cilia which move periodically. A model containing fluid inertia, which is often negligible in micro-fluidics, is solved with a finite element method. The obtained velocity field is used as an input for tracking passive particles during multiple actuation cycles. It is found that fluid inertia causes a net flow opposite to that found in Stokes flow, and results in better distributive mixing than Stokes flow. Next the simulations are compared with optical coherence tomography experimental data and the simulations which contain fluid inertia are in close agreement with the experiments. Therefore inertia is the cause for the exceptionally good mixing in these devices. [1] J.M.J. den Toonder, F.M. Bos, D.J. Broer, L. Filippini, M. Gillies, J. de Goede, G.N. Mol, W. Talen, J.T.A. Wilderbeek, V. Khataavkar and P.D. Anderson, Artificial cilia for active micro-fluidic mixing, Lab Chip, 8, 533-541, 2008

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Date submitted: 04 Aug 2008

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