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Dynamics of flexible fibers transported in confined viscous flows[1]

JEAN CAPPELLO, PMMH-ESPCI, Paris, CAMILLE DUPRAT, LadHyX, Polytechnique, Palaiseau, OLIVIA DU ROURE, PMMH-ESPCI, Paris, MATHIAS NAGEL, FRANOIS GALLAIRE, EPFL, Lausanne, ANKE LINDNER, PMMH-ESPCI, Paris — The dynamics of elongated objects has been extensively studied in unbounded media as for example the sedimentation of fibers at low Reynolds numbers. It has recently been shown that these transport dynamics are strongly modified by bounding walls. Here we focus on the dynamics of flexible fibers confined by the top and bottom walls of a microchannel and transported in pressure-driven flows. We combine well-controlled microfluidic experiments and simulations using modified Brinkmann equations. We control shape, orientation, and mechanical properties of our fibers using micro-fabrication techniques and in-situ characterization methods. These elastic fibers can be deformed by viscous and pressure forces leading to very rich transport dynamics coupling lateral drift with shape evolution. We show that the bending of a perpendicular fiber is proportional to an elasto-viscous number and we fully characterize the influence of the confinement on the deformation of the fiber. Experiments on parallel flexible fibers reveal the existence of a buckling threshold.

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