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Elastic instability in straight channels ANNIE COLIN, HUGUES BODIGUEL, JULIEN BEAUMONT, University Bordeaux 1 — Polymer solutions exhibit purely elastic flow instabilities even in the absence of inertia. The almost ubiquitous ingredient of such an elastic instability is the curvature of streamlines: polymers that have been extended along curved streamlines are taken by fluctuations across shear rate gradient in the unperturbed state which, in turn, couples the hoop stresses acting along the curved streamlines to the radial and axial flows and amplifies the perturbation. It has been tacitly assumed for over 30 years that in line with this instability scenario, visco-elastic parallel shear flows are stable, since the streamlines are straight. Recently, Saarloos and coworkers [1] derived a general instability criterion, which shows that these flows invariably exhibit a nonlinear instability. At this stage only a few studies support and validate this analysis [2]. In this work, we take advantage of microfluidic devices and study the flow of highly elastic polymers and surfactant solutions in a straight microchannel located after a constriction. The velocity of the solution is measured using Particle Imaging Velocimetry. The amplitude of the perturbation is controlled by the shape of the constriction. Using such devices, we present a comprehensive flow diagram in the parameter plane amplitude of the perturbation, Weissenberg number. 1/ Bernard Meulenbroek at all J. Non-Newtonian Fluid Mech. 116 (2004) 235–268 2/ Daniel Bonn et all Phys Rev E 84, 045301(R) (2011)

Annie Colin
University Bordeaux 1

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