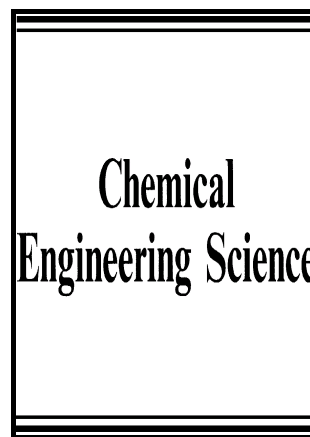


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Breakup dynamics of slender droplet formation in shear-thinning fluids in flow-focusing devices

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Abstract This work reports the breakup dynamics for slender droplet formation in shear-thinning fluids in flow-focusing devices consisted of respectively 600 μm and 400 μm square microchannels. Silicon oil droplets are generated in non-Newtonian shear-thinning fluids - polyacrylamide (PAAm) aqueous solutions. The thinning of the thread of the dispersed phase during droplet formation can be characterized by a power-law relationship with the remaining time before the final pinch-off, with an exponent of 1/3 in the non-universal collapse stage, followed by an exponent of 1 in the final universal pinch-off stage. The dependence of the pre-factors on the viscosity ratio of both phases and the capillary number is discussed. A scaling law is proposed to predict the size of droplets formed in shear-thinning fluids in such devices by taking into account the rheological property of the non-Newtonian fluids as well as the hydrodynamics.

Keywords: microfluidics, complex fluids, droplet, breakup, pinch-off, hydrodynamics

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