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Droplet velocity in microfluidics Hele-Shaw cell: effect of the disjoining pressure AXEL HUERRE, MMN, UMR CNRS 7083, ESPCI ParisTech, 75005 Paris, France, OLIVIER THEODOLY, LAI, INSERM U600, CNRS UMR 6212, Case 937, 13009 Marseille, France, ISABELLE CANTAT, IPR, UMR CNRS 6251, Universite de Rennes 1, 35000 Rennes, France, ALEXANDER LESHANSKY, Department of Chemical Engineering, Technion-IIT, Haifa, 32000, Israel, MARIE-PIERRE VALIGNAT, LAI, INSERM U600, CNRS UMR 6212, Case 937, 13009 Marseille, France, MARIE-CAROLINE JULLIEN, MMN, UMR CNRS 7083, ESPCI ParisTech, 75005 Paris, France — We present an experimental evidence of the disjoining pressure effect on the traveling velocity of highly confined viscous droplets in microfluidics. Two regimes are observed depending on the capillary number, $Ca = \mu_f U_d/\gamma$. Above a critical capillary number Ca^* the droplet velocity U_d follows $U_d \propto U_f Ca^{1/3}$, where U_f is the velocity of the carrier liquid. However, for $Ca < Ca^*$, U_d does no longer depend on Ca. We present a direct *in-situ* measurement of the lubricating film thickness. For the capillary dependent regime, we recover the classical Bretherton's scaling: $h_\infty \propto e\, Ca^{2/3}$, where e is the cell thickness. However, for $Ca < Ca^*$ the film thickness is constant and set by the disjoining pressure. For $Ca \sim Ca^*$ we observe a dynamic coexistence of two film thicknesses, a signature of an oscillatory disjoining pressure. Based on the previous work and using scaling arguments, we propose a model that is able to reproduce the experimental results.

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