Supplementary Material for

Microchannel geometry effects on nematic dowser domain dynamics

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I. Supplemental figures

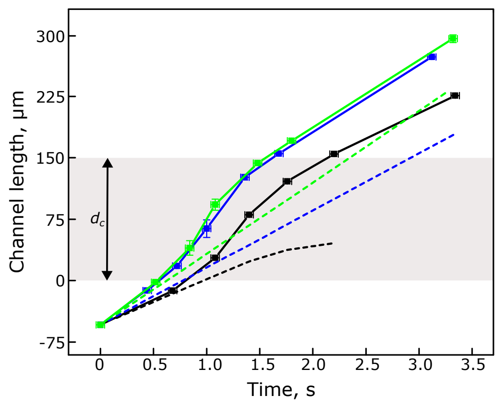

FIG. S1: Temporal evolution of the position of dowser domains in a microchannel constriction. Domains flow in a 100 µm wide linear microchannel without constriction at subcritical (black dashed line), critical (blue dashed line), and supercritical velocity (green dashed line). In a microchannel constriction of length $d_c \approx 150$ µm and width 40-50 µm, domains entering the constriction with subcritical (black solid line), critical (blue solid line), and supercritical velocity (green solid line) experience a significant acceleration. The velocity of the domains returns to its initial value as soon as they leave the constriction. The shaded region indicates the position and length d_c of the constriction within the linear microchannel.

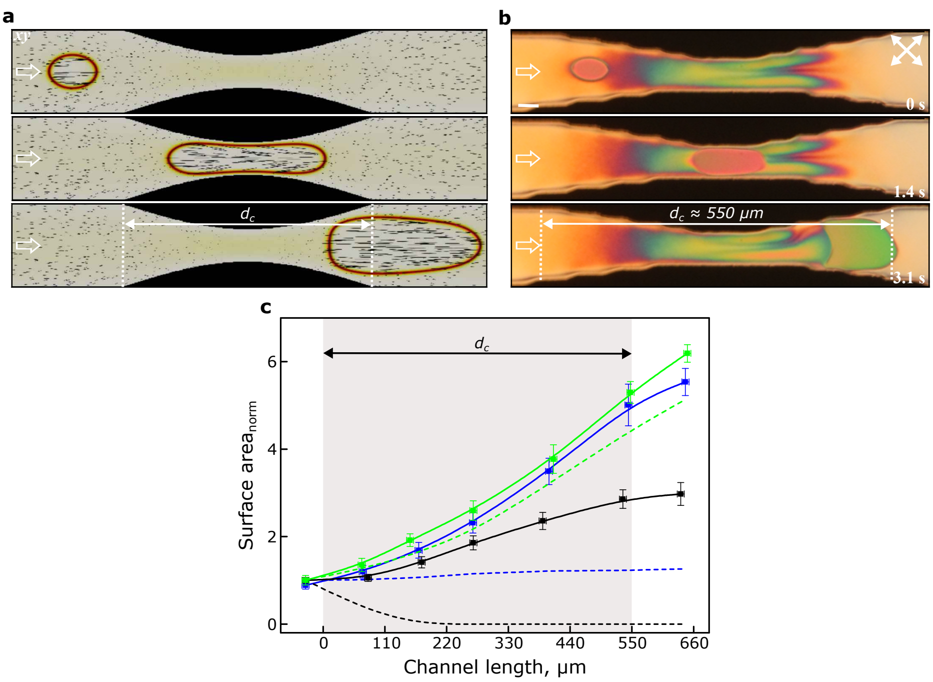

FIG. S2: Dowser domains in microchannel constriction. (a) Numerical simulations predict changes in the shape of the domains as they flow through the constriction. (b) In experiments, a domain nucleated in a 100 µm wide linear microchannel at critical velocity (≈ 42 µm/s) passes through constriction of length $d_c \approx 550$ µm in about 3.1 s. The width of the constriction is about 40-50 µm. The scale bar is 25 µm. (c) The average surface area of domains flowing in a linear microchannel with (solid lines) and without (dashed lines) constriction. All domains are nucleated in a linear 100 µm wide channel at subcritical (≈ 35 µm/s, black curves), critical (≈ 42 µm/s, blue curves), and supercritical velocities (≈ 50 µm/s, green curves). The domains accelerate and grow as they flow through the constriction. The shaded region indicates the length of the constriction in the linear microchannel, $d_c \approx 550$ µm. The surface area is normalized to the initial size, which corresponds to the critical radii of the domains as they form.

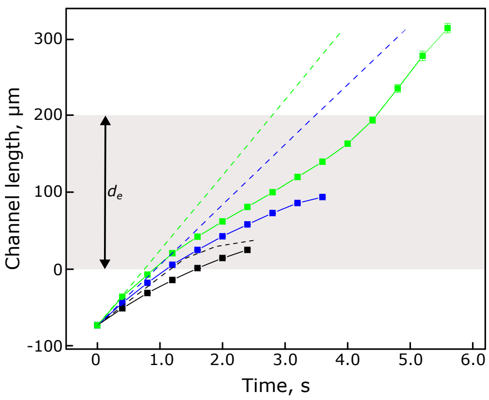

FIG. S3: Temporal evolution of the position of dowser domains in microchannel expansion. Domains flow in a 100 µm wide linear microchannel without expansion at subcritical (black dashed line), critical (blue dashed line), and supercritical velocities (green dashed line). Domains that enter the expansion with a width of 200 µm and a length of $d_e \approx 200$ µm from a 100 µm wide linear channel with subcritical (black solid curve) and critical velocities (blue solid curve) decelerate and annihilate before they have travelled the entire length of the expansion. Only domains with a velocity above the critical velocity (green solid curve) flow through the entire length of the expansion. The shaded region indicates the position and length d_e of the expansion within the linear microchannel.

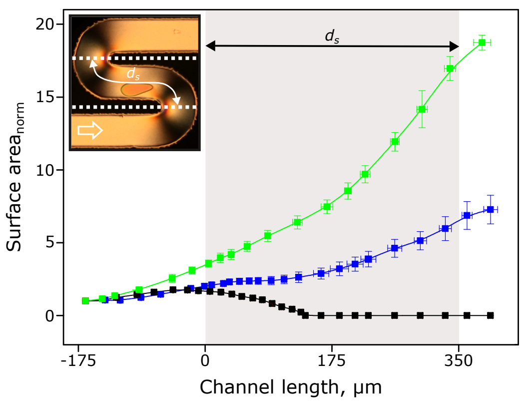

FIG. S4: The average surface area of domains flowing in a serpentine microchannel. All domains are nucleated in a linear 100 µm wide channel at subcritical (≈ 35 µm/s, black curves), critical (≈ 42 µm/s, blue curves), and supercritical velocities (≈ 50 µm/s, green curves). The domains accelerate and grow as they flow through the bends. The shaded region indicates the distance d_s between two bends, as shown in the inset. The surface area is normalized to the initial size, which corresponds to the critical radii of the domains as they form.

Videos

Video S1

Dowser domain in a microchannel constriction. Numerical simulations depicting the behavior of a dowser domain as it flows through the constriction (see Fig. 2a).

Video S2

Dowser domain in a microchannel constriction. Experimental observation of a dowser domain as it flows through the constriction (see Fig. 2b).

Video S3

Dowser domain in a microchannel expansion. Numerical simulations depicting the behavior of a dowser domain as it flows through the expansion (see Fig. 3a).

Video S4

Dowser domain in a microchannel expansion. Experimental observation of a dowser domain as it flows through the expansion (see Fig. 3b).

Video S5

Dowser domain in a serpentine microchannel. Numerical simulations showing a dowser domain flowing through a serpentine microchannel with straight bends (see Fig. 4a).

Video S6

Dowser domain in a serpentine microchannel. Numerical simulations showing a dowser domain flowing through a serpentine microchannel with curved bends (see Fig. 4b).

Video S7

Dowser domain in a serpentine microchannel. Experimental observation of a dowser domain flowing through a serpentine microchannel with curved bends (see Fig. 4c).

Video S8

Dowser domain splitting. Experimental observation of a dowser domain splitting in a microchannel with T-junction (see Fig. 4d).

Video S9

Splitting and merging of dowser domains. Numerical simulations show splitting and merging (see Fig. 5a).

Video S10

Splitting and merging of dowser domain. Experimental observation of splitting and merging (see Fig. 5b).

Video S11

Asymmetric channel. Numerical simulations show that the domain does not split in an asymmetric channel (see Fig. 5d).

Video S12

Hierarchical network. Numerical simulations show the temporal evolution of the domain in a microfluidic channel with a parallel network (see Fig. 5d).