Supplemental Information

In situ imaging of fluid dynamics and nanocarrier nucleation inside microfluidic mixing devices

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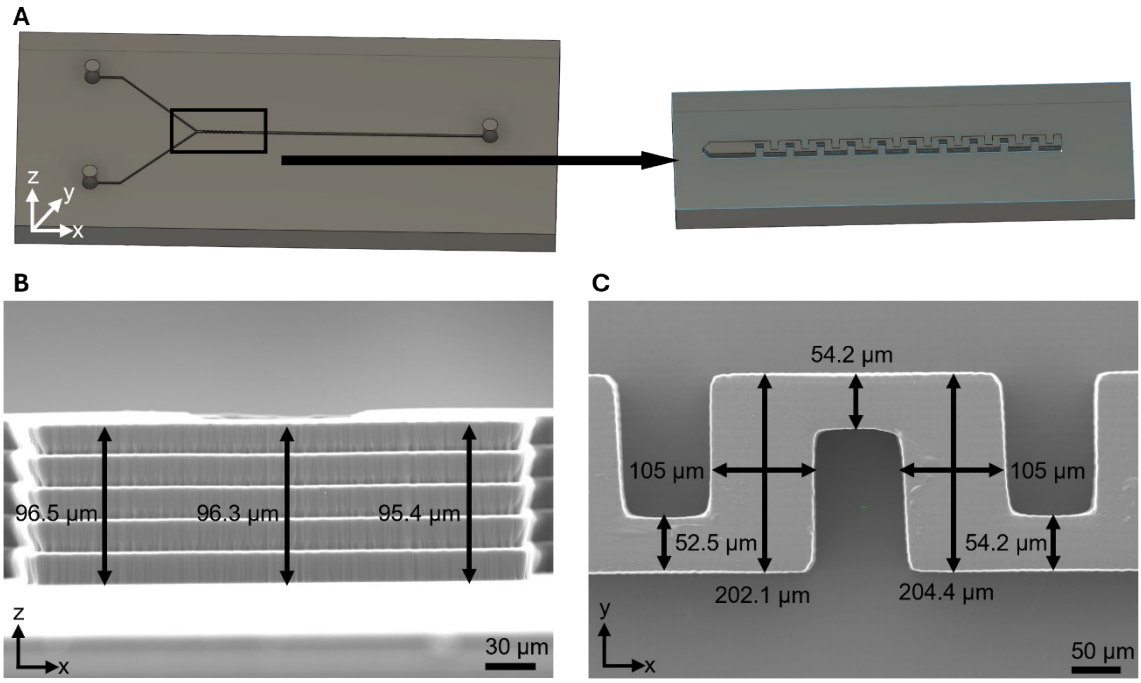
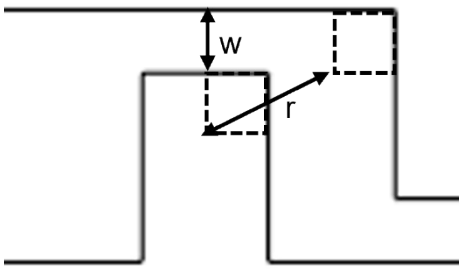


Figure S1: Quality control of the 3D printing process via scanning electron microscopy (SEM). **A**: Generated computer-aided design (CAD) structure of molds used for soft lithography (left) and corresponding smaller molds (right) needed for SEM-based measurements. **B**: x-z plane visualization of the small mold. **C**: Visualization of x-y plane of small mold.



$$Re = \frac{\rho u L}{\mu} \qquad De = Re \cdot \sqrt{\frac{L}{2r}}$$

$$L = \frac{4 \cdot w \cdot h}{2 \cdot (w + h)}$$

Figure S2: Calculation of Reynolds numbers (*Re*) and Dean numbers (*De*). Parameters used: ρ = density of the fluid [kg/m^3], u = velocity [m/s], μ = dynamic viscosity kg/m*s, h = height [m], r = radius [m], L = characteristic length [m]. The density and viscosity of the mixture were estimated using a weighted arithmetic mean of the pure-component values, assuming ideal mixing behavior, with volume fractions of 0.8 for water and 0.2 for ethanol. Values for water were retrieved from: *J. Kestin, M. Sokolov and W. A. Wakeham, Viscosity of liquid water in the range −8 °C to 150 °C, **J. Phys. Chem. Ref. Data**, 1980, **7**, 941–948, DOI: 10.1063/1.555581.* Values for ethanol were retrieved from: *F. A. M. M. Gonçalves, A. R. Trindade, C. S. M. F. Costa, J. C. S. Bernardo, I. Johnson, I. M. A. Fonseca, A. G. M. Ferreira, PVT, viscosity, and surface tension of ethanol: New measurements and literature data evaluation, **J. Chem. Thermodyn.**, 2010, **42**, 1039–1049, DOI: 10.1016/j.jct.2010.03.022.*

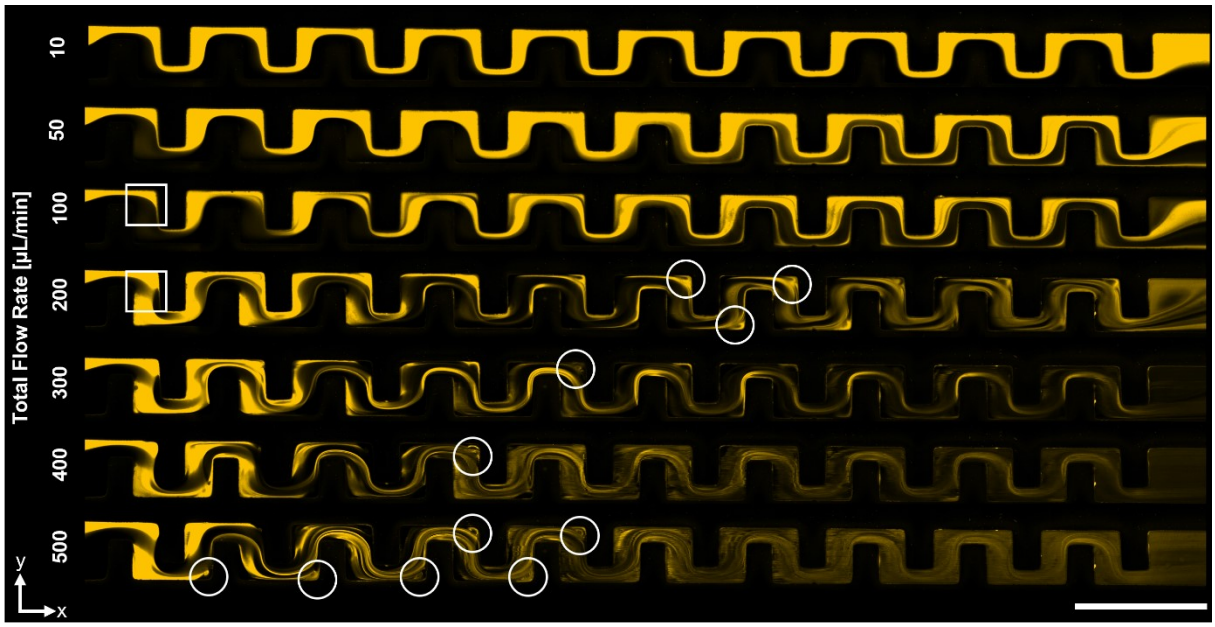


Figure S3: Visualization of flow dynamics at different total flow rates over the entire channel structure. CFM micrographs show the Rhodamine B-labeled ethanolic phase false-colored in yellow (20x magnification). Scale bar represents 200 µm.

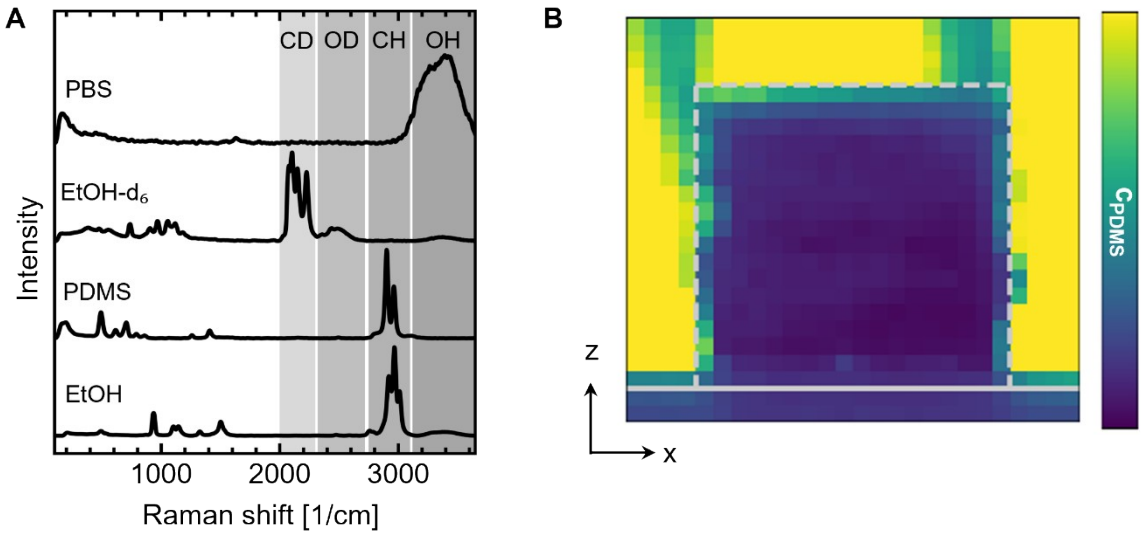


Figure S4: Identification of microchannel boundaries via CRM cross-sections using CLS analysis. A: Raman spectra of individual components. Characteristic vibrational bands are highlighted in grey: OH (PBS), CD and OD (EtOH-d_6), and CH (PDMS). **B:** PDMS CLS factor heatmap from a cross-section after the fourth baffle. Channel boundaries were defined by the contrast between blue and yellow regions and are indicated by white dashed lines.