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Dynamical phase separation using a microfluidic device: experiments and modeling. BENJAMIN AYMARD, URBAIN VAES, Imperial College London, ANAND RADHAKRISHNAN, University College London, MARC PRADAS, The Open University, ASTERIOS GAVRIILIDIS, University College London, SERAFIM KALLIADASIS, Imperial College London, COMPLEX MULTI-SCALE SYSTEMS TEAM — We study the dynamical phase separation of a binary fluid by a microfluidic device both from the experimental and from the modeling points of view. The experimental device consists of a main channel (600μm wide) leading into an array of 276 trapezoidal capillaries of 5μm width arranged on both sides and separating the lateral channels from the main channel. Due to geometrical effects as well as wetting properties of the substrate, and under well chosen pressure boundary conditions, a multiphase flow introduced into the main channel gets separated at the capillaries. Understanding this dynamics via modeling and numerical simulation is a crucial step in designing future efficient micro-separators. We propose a diffuse-interface model, based on the classical Cahn-Hilliard-Navier-Stokes system, with a new nonlinear mobility and new wetting boundary conditions. We also propose a novel numerical method using a finite-element approach, together with an adaptive mesh refinement strategy. The complex geometry is captured using the same computer-aided design files as the ones adopted in the fabrication of the actual device. Numerical simulations reveal a very good qualitative agreement between model and experiments, demonstrating also a clear separation of phases.

Benjamin Aymard
Imperial College London

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