Abstract Submitted
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Pattern formation in nonlinear solutal Marangoni convection: three-dimensional simulations vs. experiments[1] THOMAS KOELLNER, TU Ilmenau, Germany, KARIN SCHWARZENBERGER, KERSTIN ECKERT, TU Dresden, Germany, THOMAS BOECK, TU Ilmenau, Germany, MARANGONI INSTABILITY COLLABORATION — We present simulations and related experiments of the stationary solutal Marangoni convection. We performed three dimensional DNS of a 2-layer fluid-fluid system with surfactant transfer from one layer to the other. Our simulations successfully reproduced the diverse set of flow patterns, which was so far only observed in the experiments. The highly resolved simulations are performed with a specialized spectral method. The experimental system is modeled by two immiscible Newtonian fluids. Both fluids are separated by a plane interface. Initially, a surface active agent(surfactant) is dissolved in the upper phase. The purely diffusive transport of the surfactant is unstable to the stationary Marangoni instability due to variations of the interfacial solute concentration. The surfactant transport at the interface is modeled by Henry's law. The Schmidt number for the considered organic surfactant is usually much more than a thousand. The dynamics of the evolving patterns are described in detail and compared to experimental observation for a cyclohexanol/water system with butanol as transported solute. We classify the emerging structures and analyze their characteristic length scales in terms of the velocity and surfactant distribution.

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