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Displacement flows between Newtonian fluids at moderate Reynolds numbers in rectangular channels PRASHANT VALLURI, Imperial College London, HANG DING, University of California, Santa Barbara, PETER SPELT, OMAR MATAR, Imperial College London — Displacement flows between two Newtonian fluids in rectangular channels is studied by numerical and analytical means. Two-stages are clearly seen in the displacement process: first, a core of the displaced fluid is removed by a finger of the displacing fluid with width less than the channel height; then, the film of the displaced fluid adjacent to the wall left behind is then removed via interfacial instabilities that grow spatio-temporally. The shape of the finger dictated by a meniscus in the front and a tail of nearly asymptotic height; the latter is a function of the viscosity and density ratios, Weber number and Reynolds number. This dependence is studied by means of highly resolved direct numerical simulations using the diffuse-interface method. The interface shapes obtained is compared with analytical steady state solutions of the meniscus shapes in the downstream region and the asymptotic film thickness in the upstream region.

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