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Inertial instability of miscible fluid stratifications in square microchannels[1] XIAOYI HU, THOMAS CUBAUD, Stony Brook University — The stability of stratifications made between miscible fluids having large differences in viscosity is experimentally investigated in square microchannels. Parallel fluid layers with a fast central stream and a slow sheath flow are produced by focusing low-viscosity fluid with high-viscosity fluid in a straight microchannel. We examine in particular the formation and evolution of periodic wave trains at each fluid interface over a range of fluid viscosities and flow rates. This study shows that miscible fluid arrangements can be destabilized for moderate Reynolds numbers. Several relationships are developed for the propagating velocity, size, and frequency of generated waves. In the unstable regime, minute amount of high-viscosity fluid is entrained and blended into the low-viscosity fluid recirculating plumes formed by the traveling waves. This phenomenon provides new insights into the development of microfluidic methods for continuously mixing high- and low-viscosity fluids.

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