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Capillary instability driven by a permeability gradient TALAL AL-HOUSSEINY, Department of Chemical and Biological Engineering, Princeton University, JESUS HERNANDEZ, Department of Physics, California State University at Northridge, JEFFREY ARISTOFF, Department of Mechanical and Aerospace Engineering, Princeton University, SUZIE PROTIERE, CNRS - Institut Jean Le Rond d'Alembert, HOWARD STONE, Department of Mechanical and Aerospace Engineering, Princeton University, COMPLEX FLUIDS LAB - PRINCETON UNIVERSITY TEAM — Viscous fingering, the phenomenon associated with the Saffman- Taylor instability, occurs when a low viscosity fluid penetrates a fluid of higher viscosity. Surface tension generally acts to stabilize the interface of the two fluids. In this work, we study a new surface-tension-induced instability that is driven by a permeability gradient. The instability is even revealed when a fluid of higher viscosity penetrates a fluid of lower viscosity (stable in the Saffman-Taylor sense). This capillary instability is demonstrated in a microfluidic setup composed of two symmetric channels that linearly increase in width, rather than the traditional Hele-Shaw cell. The conditions necessary to achieve this instability are studied. In particular, we determined a critical capillary number below which the instability occurs. The effect of viscosity ratio and permeability gradient are also examined.

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