Direct numerical simulation of multiphase flow of complex fluids through capillary pores

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ABSTRACT:

An annular liquid film lining a capillary pore can become unstable under the influence of surface tension and form liquid plugs that occlude the subsequent flow within the pore. The formation of liquid plugs from annular films of complex fluids -- usually films of non-Newtonian polymer and surfactant solutions -- plays a critical role in two-phase flows in porous media, and impacts many food and biological processes ranging from pulmonary flow to drying of foodstuff. Here we analyze the time evolution of annular films of complex fluids in capillary pores using direct numerical simulation, and show how non-Newtonian effects interact with interfacial flows induced by uneven distribution of surfactants (Marangoni flows) modulating the formation of liquid plugs within the pore.