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Numerical simulations of immiscible two-fluid channel flow in the presence of phase changes[1] DANIELE SILERI, HANG DING, KIRTI SAHU, OMAR MATAR, Imperial College London — We study the interaction between a fast-flowing fluid over a highly viscous layer in a two-dimensional channel using direct numerical simulations; the two fluids are immiscible. The flow regime varies from stratified-wavy to dispersed for moderate to high Reynolds numbers, respectively. The equations of mass, momentum and energy conservation in both fluids are solved using a procedure based on the diffuse interface method. This equation set is complemented by the Cahn-Hilliard equation for the volume fraction. No-slip and no-penetration conditions are imposed at the walls, and constant flow rate and outflow conditions are prescribed at the inlet and outlet, respectively. Our model accounts for the formation of the highly viscous fluid due to phase change in the bulk fluid, which is ultimately deposited at the wall. This is driven by thermal instability, which is taken into account using a chemical equilibrium model based on the Gibbs free energy. We present results showing typical flow dynamics and the effect of system parameters on the average deposit thickness. This work is of direct relevance to 'fouling' in oil-and-gas refineries.

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