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Solutal Marangoni instability in layered two-phase flow JASON PICARDO, T.G. RADHAKRISHNA, S PUSHPAVANAM, Indian Inst of Tech-Madras — In this work, the instability of layered two-phase flow caused by the presence of a surface-active solute is studied. The fluids are density matched to focus on surfactant effects. The fluids flow between two flat plates, which are maintained at different solute concentrations. This establishes a constant flux of soluble surfactant from one fluid to the other, in the base state. A linear stability analysis is carried out, supported by energy budget calculations. The flow is first analyzed in the creeping flow regime. Long wave as well as short wave Marangoni instabilities are identified, each with a distinct energy signature. The short wave instability manifests as two distinct modes, characterized by the importance of interfacial deformations or lack thereof. The primary instability switches between these different modes as parameters are varied. The effect of small but finite inertia on these solutal Marangoni modes is then examined. The effect of soluble surfactant on a finte inertia flow is also studied, with focus on the transition from the viscosity-induced instability to solutal Marangoni instability. This analysis is relevant to microfluidic applications, such as solvent extraction, in which mass transfer is carried out between stratified immiscible fluids.

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