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Thermo/Soluto-capillary instabilities in evaporating bi-component liquid layers using DNS[1] ADAM WILLIAMS, University of Edinburgh, PEDRO SENZ, Massachusetts Institute of Technology, KHELLIL SEFIANE, PRASHANT VALLURI, University of Edinburgh — We investigate the stability, flow dynamics and evaporation kinetics of bi-component miscible liquid layers subject to a horizontal temperature gradient by means of two-phase direct numerical simulation. Flow is dominated by surface tension and driven by both thermal and solutal Marangoni effects, in which thermophoresis and mixture thermodynamics play a role. We employ a 3D model based on the Volume-of-Fluid method to account for the deformable liquid-gas interface. We note that the addition of a second species to the liquid phase affects the stability of the laterally heated layer over the single component case. We focus on systems with low Prandtl numbers (Pr <1) and find that the layer is unstable for a certain critical Marangoni number, exhibiting the so-called hydrothermal waves. The structure of internal flow is a strong function of the instability and this we are also able to determine. Phase-separation/segregation within the liquid is more pronounced in evaporating systems, as is its effects on the hydrothermal waves. Our results show that solutal Marangoni convection is not only stronger in evaporating systems but also has a destabilising effect on the layer.

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