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Stability of evaporating sessile drops comprising binary mixtures[1]
KATIE THOMSON, ADAM WILLIAMS, University of Edinburgh, GEORGE KARAPETSAS, Aristotle University of Thessaloniki, OMAR MATAR, Imperial College London, KHELLIL SEFIANE, PRASHANT VALLURI, University of Edinburgh — The evaporation and spreading dynamics of a binary mixture sessile drop are complex due to the interplay of thermal and solutal Marangoni stresses alongside the hydrodynamic transport, evaporation, mass diffusion, capillary stress and surface tension of the drop. We investigate the stability of volatile bicomponent sessile drops with high wettability comprising ethanol-water deposited onto heated substrates. We obtain the transient base state using a one-sided model under lubrication approximation before freezing the base state and introducing small disturbances to perform a quasi-steady-state linear stability analysis. The base state equations are derived assuming an ideal miscible mixture and the surface tension linearly depends on temperature and concentration. The stress singularity at the contact line is avoided by including a precursor film. We end up with an eigenvalue problem where the stability of the flow is determined from the real part of the eigenvalues. The stability equations for the binary system are solved to reveal the most dangerous unstable nodes. Our stability analysis shows that any evaporating sessile drop comprising a binary mixture is highly unstable and the results qualitatively agree with behaviour seen in experiments for ethanol-water.

[1]EC-RISE-ThermaSMART

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