Linear stability analysis on the evaporation of sessile drops: formation of hydrothermal waves

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ABSTRACT

Recent experiments on the evaporation of sessile droplets have revealed the spontaneous formation of various patterns including, under conditions, the presence of hydrothermal waves [1]. Prior to this work, hydrothermal waves have been observed, in the absence of evaporation, in thin liquid layers subjected to an imposed temperature gradient [2]. In this case, however, the temperature gradients and the drop thickness vary spatially and temporally and are a natural consequence of the evaporation process. We examine the evaporation of a droplet that has been deposited on a heated surface and investigate theoretically the mechanisms that drive pattern formation. We use the finite element method to solve numerically the axisymmetric problem and perform a linear stability analysis around this base state taking into account the presence of non-axisymmetric perturbations. We discuss our numerical results and compare them with 3D simulations, the latter performed using the volume-of-fluid method.

REFERENCES

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