

Flow Over a Sharp Chemical Step in the Lubrication Approximation

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The lubrication approximation has been used very successfully to describe flow of thin liquid films on homogeneous substrates. We extend the lubrication approximation to the case of chemically patterned substrates with sharp chemical steps. Using the technique of matched asymptotic expansions we derive boundary conditions for the equation of thin film flow at the chemical step: the film height, the gradient of the height, the reduced pressure, and the current have to be continuous. With this result we study the structure of a falling liquid film in the vicinity of a straight chemical step and find wake solutions. The liquid film has a depression or a ridge on the up-stream side of the chemical step. For large driving forces of the film damped oscillation develop in the thin film.