Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

Shear flow past 2D droplets pinned or moving on an adhering channel wall at moderate Reynolds numbers PETER SPELT, Department of Chemical Engineering, Imperial College London — Numerical simulations are presented of shear flow past two-dimensional droplets on an adhering wall, at moderate Reynolds numbers. The results have been obtained using a novel extension of a level-set method to simulate moving contact lines (with measures to eliminate any errors in the conservation of mass of droplets). First, the case is considered of droplets whose contact lines are pinned. Data are presented for the critical value of the dimensionless shear rate (a Weber number, We), beyond which no steady state is found, as a function of Reynolds number, Re. It is shown that, as Re is increased, the critical value of We (denoted by a subscript c) changes from $We_c \sim Re$ to We_c=const., and that the deformation of droplets at We just above We_c changes fundamentally from a gradual to a sudden dislodgement. In the second part of the presentation, contact lines are allowed to move. The contact-line singularity is removed by using a Navier-slip boundary condition. It is shown that macroscale contact angles can be defined that are primarily a function of the capillary number based on the contact-line speed, not of the value of We and Re of the shear flow. In a third part of the presentation, results are presented for droplets moving on a wall with position-dependent sliplength or contact-angle hysteresis, in an effort to stabilize or destabilize droplets.

Peter Spelt
Department of Chemical Engineering, Imperial College London

Date submitted: 09 Aug 2005 Electronic form version 1.4