EFFECT OF VISCOSITY RATIO AND EMULSIFIER CONCENTRATION AND TYPE ON AVALANCHES OF COALESCENCE EVENTS IN EMULSIONS

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The destabilization of emulsions and foams due to coalescence is an important issue regarding the stability of industrial products e.g. in the food industry. Recently, avalanches of coalescence events driven by capillary shape relaxation were reported for water-in-oil emulsions. The first event was induced using a microfluidic or a millifluidic device, where the local external flow tended to separate adjacent drops [1-3]. In the present work, in addition to the geometry of the main channel hosting the flow of drops, side-channels placed laterally to the main channel were used to control inter-drop collisions and separations. The first coalescence event and the occurrence of avalanches was then studied as certain parameters were varied, i.e. the viscosity ratio of the water to the oil phase, the contact time between adjacent drops after collision, and the concentration and the type of surfactant used. Systematic variation of the viscosity ratio was carried out using Newtonian polydimethylsiloxane fluids and mixtures of water with glycerine. At high flow rates from the lateral channels to separate adjacent drops, it was possible to separate them without triggering coalescence. The critical hydrodynamic stress needed to avoid coalescence and the probability of avalanche occurrence both increased, as the contact time between drops was increased, i.e. as the drainage of the lubricating film proceeded during a longer time. The occurrence of avalanches was observed for viscosity ratios in the range 0.001 – 10. Emulsifiers soluble in the water phase appeared not to prevent the avalanche propagation. In the presence of an emulsifier in the oil phase, the viscosity ratio appeared to be an important parameter regarding the avalanche propagation. Recent experimental results using an AFM apparatus, shed light on how coalescence can occur as two drops are pulled apart, and were in agreement with simulation results [4].

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