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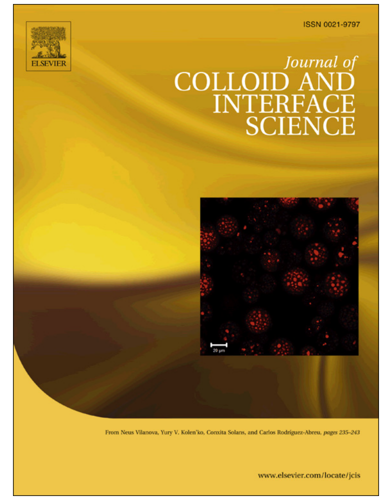

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Mapping coalescence of micron-sized drops and bubbles

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Abstract

Emulsion formulation, solvent extraction and multiphase microfluidics are all examples of processes that require precise control of drop or bubble collision stability. We use a previously validated numerical model to map the exact conditions under which micron-sized drops or bubbles undergo coalescence in the presence of colloidal forces and hydrodynamic effects relevant to Brownian motion and low Reynolds number flows. We demonstrate that detailed understanding of how the equilibrium surface forces vary with film thickness can be applied to make accurate predictions of the outcome of a drop or bubble collision when hydrodynamic effects are negligible. In addition, we illuminate the parameter space (*i.e.* interaction velocity, drop deformation, interfacial tension, *etc.*) at which hydrodynamic effects can stabilise collisions that are unstable at equilibrium. Further, we determine conditions for which drop or bubble collisions become unstable upon separation, caused by negative hydrodynamic pressure in the film. Lastly, we show that scaling analyses are not applicable for constant force collisions where the approach timescale is comparable to the coalescence timescale, and demonstrate that initial conditions under these circumstances cannot be ignored.

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