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A PIV Study of Drop-interface Coalescence with Surfactants¹

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In this work, the coalescence of a drop with an aqueous-organic interface was studied by Particle Image Velocimetry (PIV). The effect of surfactants on the drop surface evolution, the vorticity field and the kinetic energy distribution in the drop during coalescence were investigated. The coalescence took place in an acrylic rectangular box with 79% glycerol solution at the bottom and Exxsol D80 oil above. The glycerol solution drop was generated through a nozzle fixed at 2cm above the aqueous/oil interface and was seeded with Rhodamine particles. The whole process was captured by a high-speed camera. Different mass ratios of non-ionic surfactant Span80 to oil were studied. The increase of surfactant concentration promoted deformation of the interface before the rupture of the trapped oil film. At the early stages after film rupture, two counter-rotating vortices appeared at the bottom of the drop which then travelled to the upper part. The propagation rates, as well as the intensities of the vortices decreased at high surfactant concentrations. At early stages, the kinetic energy was mainly distributed near the bottom part of the droplet, while at later stages it was distributed near the upper part of the droplet.

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