A model of bubble coalescence in the presence of a nonionic surfactant with a low bubble approach velocity

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Abstract

A bubble coalescence model for a solution with a nonionic surfactant and with a small bubble approach velocity was developed, in which the mechanism of how coalescence is hindered by Marangoni stress was quantitatively analyzed. The bubble coalescence time calculated for ethanol-water and MIBC-water systems were in good agreement with experimental data. At low surfactant concentrations, the Marangoni stress and bubble coalescence time increased with bulk concentration increase. Conversely, in the high concentration range, the Marangoni stress and coalescence time decreased with bulk concentration. Numerical results showed that the nonlinear relationship between coalescence time and surfactant concentration is determined by the mass transport flux between the film and its interface, which tends to diminish the spatial concentration variation of the interface, i.e., it acts as a "damper". This damping effect increases with increased surfactant concentration, therefore decreasing the coalescence time at high concentrations.

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