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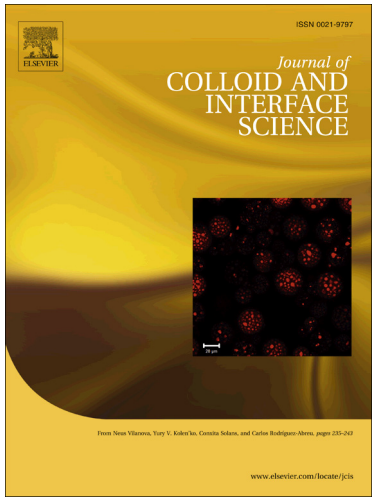

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The effect of surfactant crystallization on partial coalescence in O/W emulsions

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Abstract

Partial coalescence is a ubiquitous instability in emulsions whose dispersed phase is partially crystallized. When emulsions are stabilized with proteins, interfacial stiffness and long-range repulsive surface forces hinder this type of instability. The addition of low molecular weight surfactants modifies the interfacial properties and surface forces, generally promoting partial coalescence. In the present work, various surfactants (Tween® 80, palmitic acid and monoglycerides) differing in their crystallization temperature were probed for their ability to induce partial coalescence in model O/W emulsions stabilized by sodium caseinate. The initially fluid emulsions were submitted to a tempering cycle leading to the gelation of the system. The extent of partial coalescence was evaluated by measuring the bulk storage modulus. DSC was used to determine the melting range of the oil phase and surfactants, while polarized microscopy, Raman imaging, and surface rheology measurements were performed to characterize the oil/water interface. The experimental conditions in terms of droplet size, surfactant-to-protein molar ratio and tempering history favoring partial coalescence were first explored in presence of Tween® 80. We show that partial coalescence is rather marginal when crystallizable surfactants are added, and pronounced with liquid surfactants. The phenomena underlying this result, especially interfacial crystallization of surfactants, are evidenced and discussed.

Keywords: Partial coalescence, emulsions, surfactants, interfacial crystallization, hydrocarbon chains, Raman imaging, elastic modulus, surface tension