Thermal characterization of emulsions stabilized by Sodium Dodecyl Sulfate

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Emulsions are systems formed by drops of one liquid phase, suspended in another continuum phase immiscible to the dispersed phase. Emulsions are of great interest in food, cosmetics, and drug delivery, due to their ability to encapsulate and store molecules of biological interest inside the suspended drops. As emulsions are metastable systems, their lifetime depends upon factors as the bulk viscosity, interfacial tension and elasticity between phases and interfacial viscosity; size of drops and densities are also important [1]. Despite the numerous applications which emulsions have, the mechanisms of destabilization are still poorly understood. Therefore, development of new ways of characterization is required.

Photothermal techniques have been used successfully for the study of nanofluids, conformed by solid nanoparticles suspended in a liquid matrix [2]. In particular, the thermal wave resonant cavity (TWRC) technique together with the use of mathematical effective media thermal models has proven to be a good approach for the study of thermal transport across these colloidal systems. In this work, we propose the use of the (TWRC) technique for characterization of emulsions with different drop sizes and volume fractions of the dispersed phase.

The emulsions were prepared using olive oil as the organic phase and a solution of deionized water containing 200 mM of sodium dodecyl sulfate (SDS) anionic surfactant as the aqueous phase. The emulsification was reached, first by stirring at 200 rpm with a drip between 3 s to 5 s, then it is mixed at 300 rpm during 30 min at room temperature to do the drop size homogeneous [3]. Fresh emulsions were observed after the emulsion formation under bright field optical microscopy. The mean diameter of the emulsion drops was obtained using the image processing software ImageJ.

The thermal wave resonator cavity (TWRC) is a technique to determine thermal properties of fluid samples. This technique is based on the study of the thermal wave behavior, which is generated by a modulated laser beam, and is propagated through the material and monitored with a sensor [4]. Using the heat diffusion equation, it is possible determine the thermal properties of the fluids based in the thickness of the samples.

Fig. 1 shows the water/oil emulsions obtained by stirring. On left side it shows the emulsions of two volume fractions of oil and on the right side are observed the emulsion drops using an optical microscope.

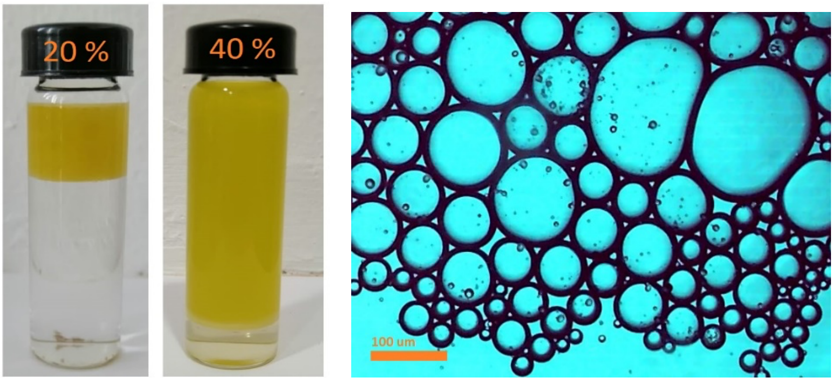

Fig. 1. Left: emulsion of water in oil at different oil volume fractions. Right: emulsion under bright field microscopy. Scale bar is 100 μm

Results for thermal diffusivity are shown in table 1. It shows thermal diffusivity of continuum phase fluid of SDS and olive oil. Effective thermal conductivity models are used to analyse the behaviour of the emulsion as the concentration is change.

Table 1. Thermal diffusivity of the phase fluid SDS and oil.

Fluid	Thermal diffusivity [m^2 s^{-1}]
SDS	1.350
Olive Oil	0.884

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