Oil/Water Separation by Using Catanionic Surfactant Mixtures

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Nano, micro or millimetre sized materials, which have self propulsion ability on liquid/air interfaces, have attracted lot of attention, and can be used in vide variety of application areas such as biomimicry, micro surgery, cordless sensors or biosensors, drug delivery, etc. This kind of materials usually use external energy sources such as light, electrical or magnetic field for the supply of the energy to move. In addition to external energy sources, self-motion of a material on liquid surface can also be provided by creating a surface tension gradient. In this case, the motion is resulting from the Marangoni effect and as a result of the surface tension difference, material moves in the direction from low surface tension to high. By using the Marangoni effect, several applications can be utilized with the asymmetrical release of surface active agents from the self-propelled material [1]. In this study usage of the Marangoni effect on self-driven polymeric capsules were studied by the addition of Sodium Dodecyl Sulphate (SDS) into the capsule precursor solution and both the motion of the capsule and the potential use of this system on cleaning the surface of water which was contaminated with oil were investigated. Since SDS lowers the surface tension, the movement of the capsule increases with the release of the surfactant, oil droplets are repulsed further and merged finally. Within this context, it is thought that the repulsion of the oil droplets would be enhanced if the surface tension difference increases. So, in this study, catanionic surfactant mixtures of SDS and Diethyl trimethyl ammonium bromide (DTAB) are also used. Due to the synergistic effect between its components, catanionic surfactant mixtures possess lower CMC values and therefore less surface tension values were obtained than the pure components of the mixtures. These mixtures with different mixing ratios are loaded into the precursor solution that will form Polyether sulfone (PES) capsules at the water surface via phase inversion. It is seen that, the motion of the catanionic mixture loaded capsules have been faster than the capsules formed just with SDS. Due to the spreading of the surfactant mixtures, the oil film on the surface turned into the lens form. Therefore, collection of the droplets became easier. Also, the oil droplets have been repulsed faster and merged within seconds. The mixtures with the mole ratio of 9/1 and 7/3 SDS/DTAB had moved the oil droplets at 60 and 55 seconds, respectively. On the other hand, the mixture of 8/2 SDS/DTAB had repelled the oil contamination in 45 seconds, which is a very short time period compared to the others.

The separation of oil from water is a vital application since water contamination effects the whole ecosystem, sometimes in an irreversible way. So, with its remarkable results, this study holds an important role in terms of cleaning and collecting the contaminations from the water surface.

[1] L. Yu, M. Cheng, M. Song, D. Zhang, M. Xiao and F. Shi, *Advanced Functional Materials* 2015, **25**, 5786.