Polyelectrolyte-surfactant mixtures adsorption onto water/solid and water/vapor interfaces: a physicochemical study with potential technological applications

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Polymer-surfactant mixtures are interesting for the development of different technological applications ranging from cosmetic to tertiary oil recovery, and from drug delivery to functional foods. Most of these applications involve the interaction between these mixtures and surfaces, either solid or fluid. Thus, the understanding of the physico-chemical bases governing the behavior and properties of these systems in bulk and at interfaces are important to optimize their use in any technological application [1].

Here, we present a comprehensive study on the behavior of mixtures formed by poly(diallyl-dimethyl-ammonium chloride) and different surfactants (sodium laureth sulfate, sodium cocoylmethyltaurate or cocoylamidopropylbetaine) of interest in the hair care industry. For this purpose, the aggregation phenomena occurring in bulk have been correlated to the adsorption of these mixtures at interfaces (solid or fluids). The interest of these results is due to the fact that conditioning performance is related to the adsorption of polyelectrolyte – surfactant complexes onto the complex hair surface. On the other side, the cleansing and foaming properties of the mixtures are make it necessary to understand the behavior of these systems at the water/vapor interfaces.

We have combined several bulk characterization techniques: dynamic light scattering, ζ-potential, turbidimetry and surface sensitive techniques such as tensiometry, quartz crystal microbalance, ellipsometry and atomic force microscopy. It has been possible to obtain a direct correlation between the bulk behavior and the adsorption properties. An enhanced adsorption was found for systems approaching to the onset of the phase separation region due to the partial sedimentation of the aggregates formed in solution. The correct choice of the surfactant nature and concentration has allowed us to tune the adsorbed amount and the hydration properties of the layers, which is very important for the cosmetic performance of these systems. The scenario is more complex when the adsorption at the water/vapor interface is considered, and no clear relationships can be obtained between the bulk behavior and the adsorbed layers.

The information contained on the adsorption results provides insights on the conditioning effect, lubrication (water content) and cleansing properties of the polyelectrolyte-surfactant mixtures.

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[1] S. Llamas, E. Guzmán, F. Ortega, N. Baghdadli, C. Cazaneuve, R.G. Rubio and G.S. Luengo, *Adv. Colloid Interface Sci.*, 2015, **222**, 461.