

## Aggregation Behavior of Binary Mixture of Sodium Dodecylsulfate and Sodium N-Lauroylsarcosinate

Osamu Kosaka, Pankaj Sehgal and Hidekazu Doe\*

*Department of Chemistry, Graduate School of Science, Osaka City University, 3-3-138 Sugimoto, Sumiyoshi-ku, Osaka, Japan.*

Surfactants are used in many applications. Our group has been interested in the interaction between surfactant micelle and some additives such as polymers and proteins. In our previous paper, we reported the interaction found in the ionic surfactant micellar solutions with environmental hormones such as bisphenol A, nonylphenol and  $\beta$ -estradiol. Herein this presentation, we chose two anionic surfactants of sodium dodecylsulfate (SDS) and sodium N-lauroylsarcosinate (SLAS). SDS is used in toothpaste. SLAS has an amino acid residue to which a long alkyl chain is attached in structure and is called "amino acid oil." The chemical structures of SDS and SLAS are similar. Therefore, it is interesting to know the interaction between them in mixed micelle and at the air/water interface. We measured interfacial tension, conductivity, steady state pyrene fluorescence, dynamic light scattering, and viscosity at each different composition of SDS and SLAS.

Every interfacial tension curve in the presence of SLAS makes a minimum just before the critical micelle concentration (*cmc*). At that concentration, the surfactant molecules start to form aggregates such as hemi-micelle at the air/water interface. The surface tension increases during the growth of hemi-micelle finally to reach a constant value at the *cmc*. In the presence of SLAS, the surface excess ( $\Gamma_{\max}$ ) of surfactant immediately decreased and took a constant value irrespective of the mole fraction of SLAS ( $\alpha_{\text{SLAS}}$ ). It indicates that SLAS adsorbs at the air/water interface exclusively. From conductivity measurements, the *cmc* was determined. The ideality of the *cmc* values was estimated to know the interaction working between SDS and SLAS at micellar surface. The interaction parameter in micelle ( $\beta^{\text{M}}$ ) of  $-0.4$  indicates a very weak attractive force. The mole fraction of SDS in micelle was larger than that of SDS in bulk phase. From steady state pyrene fluorescence measurements, the aggregation number ( $N_{\text{agg}}$ ) of mixed micelle was determined. As the  $\alpha_{\text{SLAS}}$  increases, the  $N_{\text{agg}}$  decreased. The net cross-sectional area of the amino acid residue in SLAS is considerably larger than that of the sulfate in SDS. The steric repulsion of headgroups would be large and decrease the  $N_{\text{agg}}$ . From dynamic light scattering measurements, the hydrodynamic radius ( $R_{\text{H}}$ ) of micelle decreased as the  $\alpha_{\text{SLAS}}$  increases. It is due to the decrease in the  $N_{\text{agg}}$ . As the  $\alpha_{\text{SLAS}}$  increases, the micropolarity ( $I_1/I_3$ ) in micelle did not change. It indicates that while the mole fraction of SLAS in micelle ( $\chi_{\text{SLAS}}$ ) increases, the penetration of water into hydrocarbon micellar core is very small. As the  $\alpha_{\text{SLAS}}$  increased, the degree of micelle ionization increased and the free energy of micellization ( $\Delta G_{\text{m}}^0$ ) became increasing (unstable). The amide functional group of SLAS has the two conformational forms, *cis* and *trans*. The rotational movement prevents the hydration of water and the binding of counterions. Moreover, the packing of surfactant molecules around SLAS at the micelle surface is loose, which weakens the electric repulsion of headgroups, causing the micelle ionization. As the  $\alpha_{\text{SLAS}}$  increased at the total surfactant concentration ( $C_{\text{s}}$ ) of 700 mM, the viscosity ( $\eta$ ) increased. At this  $C_{\text{s}}$ , the incorporation of SLAS in micelle would change the micellar shape.