The Interaction of a Surfactant with a Monolayer Studied by Radiotracer Method

By Ryosuke SHIMOZAWA and Ryohei MATUURA

(Received February 6, 1961)

The adsorption of sodium alkyl sulfates at the solution-air interface was studied by radiotracer method and the result was already reported[1-3]. In this case if an insoluble monolayer is present on the surface of the solution, the surface count of the radioactive detergent may be different from that of the free surface, and it is expected that we may be able to know the interaction of the detergent with the monolayer substance from this difference in the surface count. We measured the interaction of sodium dodecyl sulfate (SDS) with the monolayer of octadecyl amine, octadecyl alcohol and nylon 6 spread on the surface of the solution by tracing sulfate sulfur tagged with ^{35}S. The apparatus was almost the same as that used for measuring the adsorption of the detergent at the free surface[1]. The radioactivity of the surface of the SDS solution in the lucite tray was measured first. Then the monolayer was spread on this solution and the surface area was kept constant with the surface pressure of about 10 dyn./cm. The radioactivity of the surface in this state was measured with the same geometry as above. The spreading solvents used were a mixture of one volume ethanol and two volume benzene for octadecyl amine and octadecyl alcohol and a mixture of one volume phenol and three volume benzene for nylon 6. The result is shown in Fig. 1, in which the abscissa represents the time after spreading the monolayer on the surface and the ordinate is the surface count.

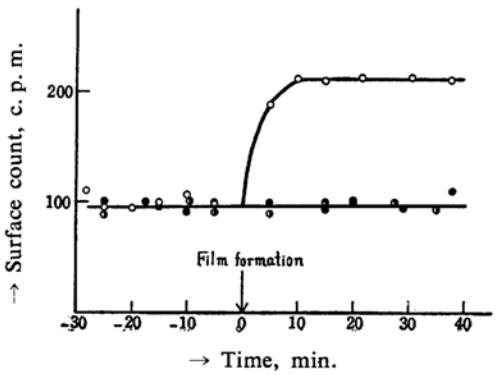

Fig. 1. Change in surface counting rate before and after film formation. Substrate is 8×10^{-5} mol./l. SDS solution.
○ Octadecyl amine-SDS series
◑ Octadecyl alcohol-SDS series
● Nylon 6-SDS series

From this figure it is evident that in the presence of octadecyl amine monolayer the surface count increases to more than twice the value of the free surface, while in the case of octadecyl alcohol and nylon 6 no change is observed after spreading the monolayer of these substances. These results may show that the monolayer of octadecyl amine interacts with the molecule of SDS in the substrate solution remarkably but that of octadecyl alcohol and nylon 6 affects no such interaction as the amine monolayer. Goddard and Schulman[4] measured the surface pressure of an eicosyl amine monolayer at constant area on the surface of water and found that a remarkable increase in pressure took place by injecting sodium hexadecyl sulfate (SHS) into the substrate solution beneath the monolayer. They explained the result in terms of penetration of SHS into the monolayer and formation of a 1 to 1 stoichiometric complex. The present experiment confirms directly the strong interaction of the long chain amine monolayer with sodium alkyl sulfate in the solution. However, we found that the surface pressure of the monolayer of octadecyl alcohol and nylon 6 increases appreciably by the presence of SDS in the solution just as is the case with the amine monolayer, but the surface count with the monolayer of the former substances does not differ from the value without the monolayer contrary to the case of the latter substance, as shown in Fig. 1. These results suggest that the mechanism of the interaction of the long chain amine monolayer with SDS is different from that of the monolayer of long chain alcohol or nylon 6 with it. The quantitative treatment of the data and the detailed discussion will be reported in future.

Department of Chemistry
Faculty of Science
Kyushu University
Hakozaki, Fukuoka

1) R. Matuura, H. Kimizuka, S. Miyamoto and R. Shimozawa, This Bulletin, 31, 532 (1958).
2) R. Matuura, H. Kimizuka, S. Miyamoto, R. Shimozawa and K. Yatsunami, ibid., 32, 404 (1959).
3) R. Matuura, H. Kimizuka and K. Yatsunami, ibid., 32, 646 (1959).
4) E. D. Goddard and J. H. Schulman, *J. Colloid Sci.*, 8, 309 (1953).