Synopsis of Original Research Paper

Fundamental study on penetration of cosmetics and water through lipid-skin model for safty

Akihiko Tanioka

Department of Organic and Polymeric Materials, Faculty of Engineering, Tokyo Institute of Technology

The transport phenomena of weak electrolytes through a charged membrane as a model of skin has been studied in order to understand the basical behavior of cosmetics in the skin. The membrane potential across positively charged and negatively charged membranes was measured for acetic acid and glycine methyl ester hydrochloride aqueous solutions as model materials of cosmetics. The anion-to-cation mobility ratios in the membrane were determined. In the case of acetic acid solutions in a positively charged membrane, the ratios were about 0.0001-0.001 times larger than those in water. On the other hand, they were about 10000 times larger than in water if a negatively charged membrane was employed. It is suggested that the transport phenomena of weak electrolyte ions in a charged membrane can be explained by the above-described transport theory.

The dissociation constant of acetic acid as a weak electrolyte in an ion-exchange membrane was estimated using the Donnan equilibrium theory. The total concentration, C_o , which represents the sum of the dissociated proton concentration and carboxyl concentration of undissociated electrolyte in the membrane, was determined by neutral titration in order to use it for the calculation. The apparent dissociation constants of acetic acid,K, in the negatively charged membrane were on the order of 10^{-4} and were larger than that in water (=1.73×10^{-5}). K(increased with an increase in the concentration in external solution and decreased with the fixed charge density increase. The larger dissociation constant in the membrane compared with that in water suggests the existence of an interaction between the solute and the membrane other than that with the electric field.

The glycine and leucine permeability coefficients, P, through a negatively membrane were measured as a function of HCl concetration, C_{HCl}, from 0 to 10^{-1}mol/l for three different interfacial conditions. Amino acid transport phenomena remarkably depended on the interfacial condition between the membrane and the external solution. The lowest P was obtained at C_{HCl}=0 for both sides of the membrane, and generally P increases with an increase in C_{HCl}. In case of the glycine, the lowest P had been obtained if C_{HCl} on the glycine source side was 10^{-1}mol/l and that on the opposite side was 0. The highest P was obtained if C_{HCl} on the amino acid source side was 0 and that on the opposite side was 10^{-1}mol/l. The P values of glycine had been explained by the transport mechanism based on the interfacial chemical reaction (protonation, deprotonation or ion-exchange) and the ionic tranport across a charged membrane. They, however, are remakably affected by the physicochemical properties of the membrane such as hydrophobicity, molecular size, etc..