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## Preparation of Organic Particles by Complexation between Cationic and Anionic Surfactants in Aqueous Solution

Dong Ran Shin <sup>a</sup>, Young Soo Kang <sup>a</sup> & Tae Hyun Chang <sup>b</sup>

<sup>a</sup> Department of Chemistry, Pukyong National University, Daeyeon-3-dong, Nam-gu, Pusan, 608-737, Korea

<sup>b</sup> Department of Chemistry, Pohang University of Science and Technology Pohang, Kyungpuk, 790-600, Korea

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## **Preparation of Organic Particles by Complexation between Cationic and Anionic Surfactants in Aqueous Solution**

DONG RAN SHIN and YOUNG SOO KANG\*

Department of Chemistry, Pukyong National University, Daeyeon-3-dong,  
Nam-gu, Pusan 608-737, Korea

TAE HYUN CHANG

Department of Chemistry, Pohang University of Science and Technology  
Pohang, Kyungbuk 790-600, Korea

**Abstract** The complexation between cationic and anionic surfactant was monitored by changing molecular ratio between cationic and anionic surfactant molecule and alkyl chain length of anionic surfactant. The precipitation was identified with elemental analysis, SEM and UV-vis spectrophotometer. The relative degree of precipitation was determined by weighing the amount of precipitation and the size of the precipitation was determined with light scattering. This study enabled the preparation of organic charge transfer complex by ionic surfactants.

**Keywords:** organic particles; surfactant

## **INTRODUCTION**

Sometimes precipitation of mixture of anionic and cationic surfactants from aqueous solution is undesirable in the cleaning of clothes,<sup>1</sup> in spite of the disadvantage of precipitation in surfactant solution, the precipitation enables the preparation of organic particle which can be utilized in chemical applications such as charge transfer complex and photodiode crystal detector materials.<sup>2,3</sup> In the present study, the organic surfactant particles have been prepared with cationic cetylpyridinium chloride and anionic sodium alkyl sulfate.

## EXPERIMENTAL SECTION

The degree of precipitation from each sample was determined by weighing each precipitation. The 1.0 mM stock solution of sodium tetra (C<sub>14</sub>), dodecyl (C<sub>12</sub>) and octyl (C<sub>8</sub>) sulfate, sodium dodecyl benzene

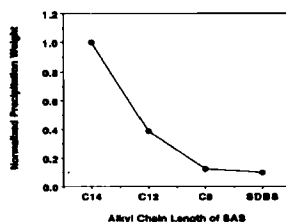


FIGURE 1. The normalized precipitation weight of surfactants versus molar ratio of cationic cetyl pyridinium chloride (CPCI) to anionic sodium dodecyl sulfate (SDS).

sulfate and cetyl pyridinium chloride in water was prepared and mixed with different molar ratio at pH=6.5 6 °C, 1.5 M NaCl concentration by volume ratio of each solution to give 1: 1, 1: 2, 1: 3 molar ratio of sodium alkyl sulfate to cetyl pyridinium chloride. The mixed solutions were stirred for 24 hrs and put in static state for 4 days and the precipitation was identified with eye. The invisible precipitation was identified after centrifugation with 10000 rpm for 30 min.

The precipitations were filtered with filter paper. The data on the amount of precipitation were normalized by dividing each weight by the highest value on the same batch. The composition were identified with elemental analysis. The particle size and morphology were obtained with light

scattering (Lexel-95 LASER INC. MALVERIN 4700 at 488 nm with argon ion) and SEM (Hitachi S-2700) image, respectively.

## RESULTS AND DISCUSSION

The data on the precipitation of the surfactant complexation between cationic and anionic molecules are shown in Figure 1 and 2. The best condition for the precipitation was equi-molar ratio of CPCl to SDS, longer alkyl chain length of SDS.

The equi-molar ratio of CPCl to SDS shows the highest precipitation of the complex. This is interpreted as the neutral charge balance between positive and negative charge results in a decreased water solubility because of the lowest polarity. This supplies the highest stability of the particle in the aqueous solution.

The longer alkyl chain of SDS resulted the higher precipitation because the longer alkyl chain should have higher degree of interaction due to the hydrophobic interaction between alkyl chains of SDS and CPCl. Also it decreases the water solubility of the complex. This interpretation is shown furthermore by the decreased precipitation with sodium dodecyl benzene sulfate. The benzene ring of sodium dodecyl benzene sulfonate has a slightly higher solubility than straight alkyl chain because of the partial hydrogen

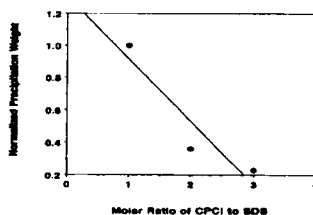


FIGURE 2. The normalized precipitation weight of surfactants versus alkyl chain length of anionic sodium alkyl sulfate (SAS).



FIGURE 3. SEM image of equi-molar ratio precipitation of CPCl and SDS.

bonding of  $\pi$ -electron on the benzene ring with water. This increases the water solubility of the complex.

The compositions of the precipitation of the complex between cationic and anionic surfactant molecules with molar ratio of cationic CPCl to SDS as 1:1, 1:2 and 1:3 is obtained from elemental analysis. The experimental composition of each precipitation by varying molar ratio of cationic cetyl pyridinium chloride to dodecyl alkyl sulfate which was almost consistent with the theoretical composition of the surfactants particles even with varying molar ratio within 5% standard deviation.

The particle sizes of the precipitation with molar ratio of cetyl pyridinium chloride to sodium dodecyl sulfate as 1:1, 1:2 and 1:3 were identified with light scattering at 488 nm and shown as 439, 326 and 308 nm. This is possibly interpreted as the precipitation size is critically dependent on the charge balance between cationic and anionic surfactant molecules. The equi-molar charge balance results in the stable particle by the precipitation.

The well formed morphology of precipitation with 1:1 molar ratio between CPCl and SDS was directly observed with SEM image as shown in Figure 3. The precipitation filtered out from aqueous solution shows the well formed organic particles in the ambient conditions.

## References

1. Fujimoto, T. *New Introduction to Surface Active Agents* ; Sanyo Chemical Ind., LTD.
2. Tanford, C. *The Hydrophobic Effect : Formation of Micelles and Biological Membranes* ; Wiley:New York; 1980.
3. Hunter, R.J. *Introduction to Modern Colloid Science* ; Oxford University Press: Oxford, 1993.