
Streaming Potential of Silver Bromide Adsorbed Thiourea, Dye, and Thiosemicarbazone*

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Shin SUZUKI, Kinji OHKUBO** and Yasuo MOROTOMI***

Department of Applied Chemistry, Faculty of Engineering,
University of Tokyo, Bunkyo-ku, Tokyo

§ 1. Introduction

The authors have studied the adsorption of several organic compounds used for photographic addition agents to silver halide grains by measuring the electrophoretic mobility of silver bromide sols in solutions of these compounds1,2,3. However, the measurement of electrophoretic mobility was elaborate, and was not applicable to unstable sol. Addition of some of these compounds to the solution made silver bromide sol unstable, and it was impossible to obtain the colloid-chemical informations about silver bromide sols. Measurement of the streaming potential is suitable for studying such an unstable sol.

§ 2. Preparation of Silver Bromide

Silver bromide precipitates were prepared by mixing solutions of silver nitrate and potassium bromide. They were thoroughly washed with distilled water, filtered, and dried between filter papers, on back of which porous plates were attached. They were stored in a desiccator for a few days.

The size of silver bromide precipitates was measured microscopically, and the diameters of the grains were estimated as the order of 10^-4 cm (Fig. 1).

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** (Present address) Research Laboratory, Fuji Photo Film Co., Ltd., Kanagawa.

*** (Present address) Shinagawa Plant, Sankyo Pharmacy Co., Ltd., Tokyo.

Fig. 1. A photomicrograph of silver bromide grains and a calibration scale.
§ 3. Apparatus and Procedure

An apparatus for measuring streaming potentials is designed and constructed as shown in Fig. 2(a). The detail of the cell is shown in Fig. 3. Silver bromide precipitates were inserted between two glass filters and compressed by these filters as compactly as possible. An aqueous solution of addition agent was forced to flow through the bed of silver bromide grains under a known pressure. The streaming potential generated between two platinum electrodes was measured by an electrometer, and the pressure difference across the bed was measured by a pressure gauge. The ratio \( E/P \) was plotted against the concentration of addition agents in a flowing solution.

§ 4. Preliminary Experiments

Sizes of silver bromide grains may change during the measurement. Then, it was investigated whether the ratio \( E/P \) varied by repeating the measurement. Results indicate that the ratio \( E/P \) does not change so remarkably when the same sample is used (Fig. 4).

§ 5. Experimental Results

Streaming potentials of silver bromide were measured by flowing aqueous solutions of some addition agents, the concentration of which was varied. Before measuring the streaming potential, silver bromide grains in a cell were left for one day in the solution, so that
the adsorption of the addition agent to silver bromide could be completely reached to an equilibrium. Results for thiourea, β-succinoyl aminobenzaldehyde-3-thiosemicarbazone, and 3, 3'-diethyl-9-methylthiacarbocyanine bromide are shown in Figs. 5, 6, and 7.

Streaming potential of silver bromide changed when thiourea and 3, 3'-diethyl-9-methylthiacarbocyanine bromide were adsorbed to silver bromide. These results show that a neutral molecule or a positive ion of the addition agent replace a bromide ion initially adsorbed on silver bromide grains. This conclusion agrees with our results on electrophoretic measurements of silver bromide sols\(^1\),\(^2\). The result for β-succinoyl aminobenzaldehyde-3-thiosemicarbazone suggests that a part of this compound seems to exist as a negative ion, and it adsorbed to vacant site of silver bromide grain surface, which probably causes a negative shift of the streaming potential of silver bromide grains. However, a positive shift of the streaming potential was observed, too. This suggests the existence of positive ion of the compound. Otherwise, it must be considered that a negative ion replaces two or more bromide ions upon its adsorption, resulting the decrease of net negative surface charges.

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**References**