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High Sensitivity Cation / Anion Sensing Based on "Extreme Emission" Fluorescent Dye Liquid Nanoemulsion

Hideaki Hisamoto

Department of Applied Chemistry, Graduate School of Engineering,
Osaka Prefecture University

Summary

In this work, highly selective and sensitive sensing method for ions was developed by using the "fluorescent dye liquid" composed of donors and acceptors realizing the ultimate sensitivity of fluorescence resonance energy transfer (FRET). Furthermore by preparing the nanoemulsion using the dye liquid, highly-sensitive sensing of important ions in seawater component was tried. In particular, highly sensitive sensing for Cl^- was demonstrated as an example.

In the fundamental study based on the dye liquid thin film, the fluorescence spectrum of the plasticized PVC film prepared with the donor dye liquid (D) and the absorption spectrum of the plasticized PVC film prepared with the acceptor dye liquid (A) showed good overlap, and clarified the applicability to the FRET system. Based on the examination of the ratio of A and D contained in the film (A / D ratio), it was clarified that a maximum of approximately 22 times higher sensitivity fluorescence can be obtained.

Application to ion sensing enabled the anion sensing based on the coextraction mechanism of protons and anions. In the case of coextraction type anion sensing, ion selectivity is generally determined by the order of hydrophobicity of anion species. Therefore, Chloride ionophore IV was applied as a chloride ionophore to improve chloride ion selectivity. As a result, selectivity improvement of about 10 times or more was observed especially for SCN^-. In the future, further improvement in selectivity can be expected from the examination of the dye liquid composition.

Concerning the nanoemulsification, examining the amount of surfactant clarified that nanoemulsions with an average particle size of about 78 nm can be obtained under optimized condition. As a result of confirming the response based on the coextraction, good spectral changes were obtained, and even in nanoemulsions, anions sensing based on the coextraction mechanism successfully worked. Further continuation of present work would lead to the development of extremely sensitive nanoemulsions for detecting cations of interest.