

## Separation and Determination of Trace Ionic Substances in Sea Water and Concentrated Electrolyte Solutions by Capillary Electrophoresis and Its Application to Speciation of Substances

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In the determination of trace amounts of various ions in concentrated electrolyte solutions, it must be noticed that the interferences from matrices contained in samples at large amounts are very serious. The separation efficiency in capillary electrophoresis is excellent, compared with the conventional methods used so far; therefore no pretreatment is required before analyzing such sample solutions. In this study, fundamentals for developing the analysis and the speciation methods for trace ions in the concentrated electrolyte solutions were studied.

1. Separation and determination of metal ions with EDTA analogues: Ethylenediamine-tetraacetic acid (EDTA) reacts with various metal ions to form negatively charged complexes. The electrophoretic mobility of the complexes becomes smaller and UV-absorption is improved. In this study, some EDTA analogues possessing aromatic moiety were synthesized and used for the determination of  $Mg^{2+}$  and  $Ca^{2+}$  in sea water, serum, and tap water samples. Detection and determination of  $Mn^{2+}$ ,  $Fe^{3+}$ ,  $Co^{2+}$ ,  $Ni^{2+}$ ,  $Cu^{2+}$ ,  $Zn^{2+}$ , etc. was also achieved.

2. Separation and determination of metal ions with pyridylazo compounds and nitrosonaphthol compounds: Pyridylazo compounds react with various metal ions to form anionic chelates possessing strong visible-absorption. The separation properties can also be controlled and improved by utilizing the stability of the chelates. In this study, 5-bromo-2-pyridylazo-4-(N-propyl-N-sulfopropyl)-aminophenol, as well as 5-nitro- analogue, was investigated, and the separation and determination of  $V^{IV}$ ,  $Fe^{2+}$ ,  $Co^{2+}$ ,  $Ni^{2+}$ ,  $Cu^{2+}$ ,  $Zn^{2+}$ ,  $Cd^{2+}$ ,  $Pd^{2+}$ , and  $Hg^{2+}$  were achieved within 7 min. The determination of  $Fe^{2+}$ ,  $Co^{2+}$ ,  $Ni^{2+}$ , and  $Cu^{2+}$ , as well as the analysis of the reaction mechanism, was also achieved using six kinds of nitrosonaphthols.

3. Analysis and speciation of inorganic anions by indirect photometric method: Even the less photo-absorptive ion can be detected sensitively by using an indirect photometry. In this study,  $Br^-$ ,  $Cl^-$ ,  $NO_3^-$ ,  $SO_4^{2-}$ ,  $ClO_4^-$ ,  $C_2O_4^{2-}$ ,  $F^-$ ,  $HPO_4^{2-}$ ,  $HCO_3^-$  were determined with UV-absorbing organic reagents and a polymer coated capillary. Inorganic anions in various water samples were determined by the proposed method.

4. Analysis and speciation of oxoacid and halide anions by direct photometric method: In the indirect method, the background absorbance is high, which causes serious baseline noise, whereas less photo-absorbing migrating solution reduces the noise. The direct method was applied to oxoacid anions, and highly sensitive detection was performed with the detection limits of about  $10^{-8}$  M levels, coupled with a useful technique of large volume sample stacking.