SUMMARY OF Ph.D. DISSERTATION

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(Title)

Electrode Kinetics of Some Metal Complexes in Hydrophobic Room-Temperature Ionic Liquids

(Abstract)

Room-temperature ionic liquids containing bis(trifluoromethylsulfonyl)imide ($TFSI^-$) have attracted much attention in the electrochemical field, because they have high thermal stability, negligible vapor pressure and hydrophobic nature. This dissertation focused on the relationship between the electrode kinetics of some metal complexes and the properties of ionic liquids.

Chapter 1 describes the background of this study and introduced the overall chapters.

Chapter 2 deals with the electric double layer structure at the interface between a metal electrode and an ionic liquid. The potential dependence of the double layer capacitance suggested that the double layer can be assumed as a single layer of the ions composing the ionic liquid.

Chapter 3 is concerned with the electrode kinetics of ferrocenium/ferrocene in ionic liquids. The diffusion of species in the ionic liquid was found to be affected not only by the size of the species but also by the charge density of the species. Furthermore, the heterogeneous rate constants of ferrocenium/ferrocene were found to depend on the viscosity of the ionic liquids.

Chapter 4 discusses the electrode kinetics of the outer-sphere redox reactions. The heterogeneous rate constants for the outer-sphere electron transfer reactions between the some metal complex redox couples in the ionic liquid were found to be dominantly determined by the nuclear frequency factor, which closely related to the dynamics of the ions composing the ionic liquid.

Chapter 5 discusses the relationship between the diffusion coefficients of M(II) (M=Fe, Co, Ni, Cu, Zn and Eu) and the solvation structure of M(II) in the ionic liquid. It was shown that the electrode potentials of M(II)/M can be predicted from the thermodynamic and spectroscopic data.

Chapter 6 is concerned with the redox battery and the electrodeposition of Sn using the ionic liquid. It was found that a redox battery having an electromotive force of more than 2 V can be realized using the reactions of iron complexes in the ionic liquid. Moreover, it was confirmed that the electrodeposition of Sn was possible in the ionic liquid.

Chapter 7 summarized the overall results and described the issues in the future.