

Extraction of Metal Ions Using Quaternary-Ammonium-Salt-Type Amphiphilic Gemini Ionic Liquids with O- and N-Containing Spacer

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It is known that amphiphilic ionic liquids containing long alkyl chains show surface activities similar to surfactants. Gemini surfactants, in which two conventional monomeric surfactants are connected by a spacer, exhibit unique behaviors, such as lower critical micelle concentration (CMC), enhanced ability to reduce surface tension compared with monomeric surfactants, and spontaneous formation of premicelles and vesicles at low concentrations. We previously developed various quaternary-ammonium-salt-type amphiphilic ionic liquids containing oxygen or nitrogen in the spacer, and their physicochemical properties, adsorption behavior at the air/water and air/ionic liquid interfaces and layer structure formation in bulk were revealed by using various measurements [1-4]. Although many studies on the extraction of metal ions using ionic liquids have been reported in recent years, no report has focused on extraction using gemini ionic liquids and their spacer structures. In this study, extraction of metal ions such as Li^+ , Cu^{2+} , and Au^{3+} was examined using the quaternary-ammonium-salt-type amphiphilic gemini ionic liquids with different spacer structures containing oxygen and nitrogen ($2\text{C}_{12}(\text{Spacer})\text{NTf}_2$, where (Spacer) = (2-O-2), (2-O-2-O-2), (2-N-2), (2/2-N-2), (3), (5), and (6)), and the effects of the length and structure of the spacers on the extraction behavior were investigated.

Fig. 1 shows the extraction ratio E of metal ions from aqueous phase into $2\text{C}_{12}(\text{Spacer})\text{NTf}_2$. The extraction ratio of Cu^{2+} in the amphiphilic gemini ionic liquids containing oxygen and nitrogen in spacer was higher than that in $2\text{C}_{12}-s\text{NTf}_2$ with alkylene spacer, indicating that the structure of the spacer significantly influenced the extraction ratio of Cu^{2+} . The extraction ratio of Cu^{2+} was higher for the 2-O-2-O-2 spacer, which has two oxygen atoms, and lower for the 2/2-N-2 spacer, which has a rigid ring structure. This suggests that the extraction ratio was improved by using a flexible spacer. On the other hand, $2\text{C}_{12}(\text{Spacer})\text{NTf}_2$ exhibited excellent extraction capacity for Au^{3+} regardless of the spacer structure.

Keywords:

Amphiphilic ionic liquids, Gemini ionic liquids, Extraction, Metal ion, Bulk property

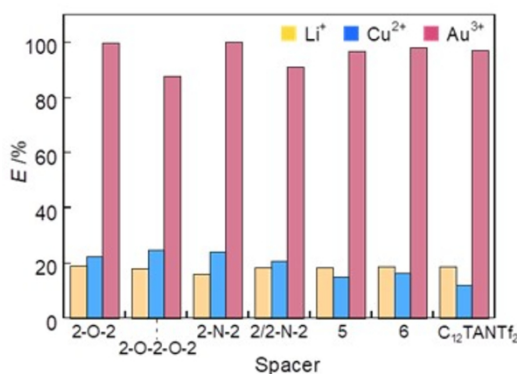


Fig. 1 The extraction ratio E of metal ions from aqueous phase into $2\text{C}_{12}(\text{Spacer})\text{NTf}_2$ at 25 °C.

References:

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