

# Development of Ion-Selective Ion Exchange Membranes and Their Application to Electrodialysis Processes

Kazuki Yamamoto

Pure and Applied Chemistry, Faculty of Science and Technology, Tokyo University of Science

## Summary

In recent years, processes aimed at recovering rare metal resources and reusing valuable ions through the selective separation of multiple ionic species contained in seawater, salt lakes, river water, and wastewater have been actively studied toward the realization of a sustainable circular society. Among such methods, electrodialysis, which utilizes ion exchange membranes to drive ion transport via electric fields, has attracted attention for its high energy efficiency and its potential applicability in resource recovery. However, technologies for the selective transport of specific ions are still under development, and the selective separation of monovalent cations such as sodium ( $\text{Na}^+$ ) and potassium ( $\text{K}^+$ ) remains a significant challenge.

In this study, we conducted electrodialysis-based desalination experiments to selectively remove specific ions from aqueous solutions containing various ions, such as those found in wastewater. To enhance the selectivity of cation exchange membranes, we attempted the synthesis of a crown ether-containing polymer (PIM-BD18C6-TB), using dibenzo-18-crown-6 as a functional monomer. As a result, the synthesized polymer showed insufficient polymerization progress, indicating the need for further optimization of the polymerization conditions. On the other hand, in electrodialysis experiments using aqueous solutions containing  $\text{Na}^+$  and  $\text{K}^+$ , we observed that when the conductivity of the dilute compartment was reduced to half its initial value, the concentration of  $\text{Na}^+$  transported was approximately 1.5 times higher than that of  $\text{K}^+$ . This result suggests that  $\text{K}^+$  was more selectively transported, which can be attributed to differences in hydration radius and ionic mobility between the two cations.