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Selective Adsorption of Ions by Porous Electrodes

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Summary

Recovery of useful ions and removal of harmful ions from seawater are long standing problems. Recently, recovery of lithium ions from seawater and removal of radioactive cesium ions are among the most urgent ones of those kinds. To solve those problems, adsorption techniques using various porous materials have been applied. Those techniques, however, are expected to consume a large amount of chemicals and generate a large amount of waste in the long run, which are problematic from the viewpoint of protection of environment and preservation of resources.

As a technique to avoid such problems, we are examining the electrochemical one using porous electrodes for which the pore size is at the nanometer scale. In the previous years, we have conducted electrochemical experiments using activated carbon fibers as the electrode and multi-component aqueous solutions as the electrolytes and have found that there seem to be conditions at which selective adsorption of ions occur. We have also found schemes to control the concentration of the aqueous solutions so that are prepared is actually the desired value, by avoiding possibility of contamination of ions from sources such as the electrode, the separator, the current collector, or the sample bottles was examined.

This year, we prepared carbon materials that are used as electrodes for the electrochemical adsorption of ions from aqueous electrolytes by modifying activated carbon fibers. We used aqueous solutions containing LiCl and CsCl for studying selective adsorption. Analysis was conducted by using several techniques including electrochemical measurements, conductivity measurements, and ion concentration measurements. We found that, from a binary aqueous solution containing LiCl and CsCl, Cs is selectively adsorbed on the negative electrodes and the adsorbed amount is three times larger than that of Li. By comparing the selectivity for different carbon materials that were used as the electrodes, it was found that there is correlation between the selectivity and the pore size distribution of the carbon material used as the electrode.