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Continuous Recovery of Iodide from Seawater Using a Flow-through Cell Composed of Selective Carbon Fiber

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Summary

Different electrode substrates were immersed in an aqueous $MnSO_4$ solution containing hexadecylpyridinium chloride ($HDPy^+Cl^-$) and then polarized at a constant potential of +1.0 V (vs. Ag/AgCl). Thus, a thin film of layered MnO_2 sandwiching $HDPy^+$ was deposited with the same amount on carbon cloth with low surface area (CC), indium tin oxide glass (ITO), and activated carbon cloth (ACC). Adsorption capabilities toward iodide ions (I^-) of the resulting HDPy/MnO_2 modified electrodes were compared. As a result, the sorption amount increased in the order of HDPy/MnO_2/ITO ≈ HDPy/MnO_2/CC << HDPy/MnO_2/ACC. This result is associated with that the unmodified ITO and CC can adsorb almost no I^- ions, while the ACC itself can adsorb them. That is, with the use of HDPy/MnO_2/ACC, I^- ions can be adsorbed both in the HDPy/MnO_2 film and on the underlying ACC. In order to examine the validity of the modified ACC electrode in seawater, its adsorption behavior toward I^- was monitored in the presence of 0.5 M NaCl. Interestingly, the HDPy/MnO_2/ACC adsorbed almost the same amount of I^- as that observed for HDPy/MnO_2/CC or HDPy/MnO_2/ITO in the absence of NaCl. This suggests that the HDPy/MnO_2 film can adsorb I^- ions even in the presence of Cl^-.

When the HDPy/MnO_2/ACC after adsorbing I^- was polarized anodically in a solution containing supporting electrolyte alone, the modified ACC could be regenerated. Specifically, the anodized electrode showed the same adsorption amount of I^- as that of the original one. This process was repeated at least three times.

A flow-through cell was assembled with ACC and HDPy/MnO_2/ACC electrodes. Here, a test solution containing I^- and supporting electrolyte was cycled in a closed flow system equipped with the cell to achieve continuous recovery and release of I^- ions by controlling the voltage between the two ACCs. However, the reversibility was poor, leaving much room for improvement.