Electrochemical separation of radioactive wastes from water

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Growing environmental concerns related to radionuclides derived from nuclear activities and accidents have spurred the development of efficient separation and removal technologies for radionuclides.[1,2] The Fukushima Daiichi nuclear power plant disaster released tons of radionuclide-contaminated wastewater into the sea. Subsequently, extensive efforts have been made to remove radionuclides,[3] especially Cs and iodine radioisotopes, from the environment.[4] Several methods such as ion-exchange,[5] sorption,[6] and solvent extraction[7] have been developed for Cs and iodine separation. However, these methods have drawbacks such as requirement of expensive materials, high operation costs, production of large amounts of secondary waste, and poor removal efficiency.

We have investigated the chemical and electrochemical separation of radioisotopes from aqueous waste solution.[1] For example, an electrode coated with a nickel hexacyanoferrate/graphene oxide (NiPB/GO) composite was evaluated its potential use for the electrochemical separation of radioactive Cs as a promising approach for reducing secondary Cs waste after decontamination. The NiPB/GO-modified electrode showed electrochemically switched ion exchange capability with excellent selectivity for Cs over other alkali metals. Furthermore, the repetitive ion insertion and desertion test for assessing the electrode stability showed that the electrochemical ion exchange capacity of the NiPB/GO-modified electrode increased further with potential cycling in 1 M of $NaNO_3$. In particular, this electrochemical treatment enhanced Cs uptake by nearly two times compared to that of NiPB/GO and still retained the ion selectivity of NiPB, suggesting that the electrochemically treated NiPB/GO composite shows promise for nuclear wastewater treatment.

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