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Development of Highly Efficient Separation Processes of Critical Metals from Sea Resources

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Summary

Deep-sea minerals such as manganese nodules and crusts, which contain valuable metals such as Co, Ni, Cu and Zn besides Mn and Fe, have been expected to be an alternative metal source from 1960's. In recent years, a stable supply of rare metals indispensable for cutting-edge industries has been concerned all over the world. Then, the value of marine resources including manganese nodules increases since valuable metals such as rare earth metals were recently identified in marine minerals. However, there are some issues to be considered for their commercial use, that is, the economic evaluation for the metals of which prices wildly fluctuate and the establishment of the mining technology. Several studies on metal leaching from mining nodules were reported, however there are almost no examples on the metal separation from the leaching solutions. In this study, we focused on manganese nodules as a resource of critical metals and investigated the recovery of rare metals from the manganese nodule.

We have synthesized novel amic acid type extractant, *N*-[*N*,*N*-di(2-ethylhexyl)aminocarbonylmethyl]glycine (D2EHAG). The extraction behavior of Co^{2+}, Ni^{2+} and Mn^{2+} was examined. It was found that D2EHAG extracted Ni^{2+} and Co^{2+} preferentially with high selectivity over Mn^{2+} from a $H_2SO_4/(NH_4)_2SO_4$ solution, while a typical organophosphorus extractant PC-88A was selective for Mn^{2+}. A significantly higher extraction ability was obtained compared with that of the synergistic system. Furthermore, quantitative stripping of Co^{2+} and Ni^{2+} from the extracting phase was achieved using 1 M H_2SO_4. The targets Ni^{2+} and Co^{2+} were separated satisfactorily and recovered from the feed solution containing Mn^{2+} through the extraction and stripping steps. Therefore, the novel D2EHAG extractant is useful for the recovery of rare metals such as Co^{2+} and Ni^{2+} from a leach solution of sea natural resources containing significant amounts of Mn^{2+}.