A Study on Inorganic-Organic Composite Host Materials for Recovery of Metal Ions

Masato MACHIDA and Tsuyoshi KIJIMA
Department of Materials Science, Faculty of Engineering
Miyazaki University

Summary

Inorganic layer compounds exhibit high capacities as a cation exchanger, but they are generally less selective. Much attention has been devoted to new families of microporous materials which can be obtained by the pillaring of inorganic layered compounds with polynuclear complex ions or bulky organic molecules. In particular, the combination with organic host molecules, e.g., calixarenes, cyclodextrins, or crown ethers are quite interesting. In the present study, we attempted to develop a novel class of such organic and inorganic double-host materials, with the expectation that they would act as including agents with high selectivity. Calixarenes as well as cyclodextrin having cationic or hydrophilic character can be incorporated into montmorillonite or zirconium phosphate (a- and g-ZrP). The arrangement and the quantity of these interlayer organic hosts were deduced from X-ray diffraction (XRD) and thermogravimetry (TG), respectively. The interlayer arrangement varied with depending on the interactions between organic hosts and those between organic hosts and inorganic layers. For the combination with crown ether compounds, 1,4,10,13-tetraoxa-7,16-diazacyclooctadecane (TDCO) was used as an intercalant because the aza-groups of this organic host were expected to react easily with inorganic layers via hydrophilic interaction. The XRD studies during intercalation suggested that TDCO molecules were incorporated into the interlayer spacing of ZrP as bilayer configuration with their molecular plane parallel to the inorganic layer. The g-ZrP-TDCO complex showed Li-ion exchange property much more faster than neat g-ZrP.

Fabrication of membranes from inorganic layer compounds must be another problem for the practical application as an ion exchanger. This study revealed that dip-coating of sol obtained from swelling layer compounds (such as montmorillonite) can produce membranes with high quality. Also, the partial pillaring of interlayer spacing with aluminum oxide is effective to provide the porous membrane structure.