Electrodeposition of In-Sn Alloys in EMI·BF_4·Cl Molten Salts

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EMI-BF_4-Cl melt has some attractive properties such as a low melting point below room temperature, a low reactivity to air and moisture, a wide electrochemical window of *ca*. 3V, and a high solubility of metal chlorides. The last one is appropriate to study the electrode reaction of various kinds of metal ions, which are difficult to dissolve in other room temperature molten salts except chloroaluminate melts. Therefore, we have been investigating the electrochemistry of metal ions such as In(III), Sn(II), Pb(II), and Sb(III) in the EMI-BF_4-Cl melt, and the results have demonstrated that such metals are each electrodeposited. In this study, the possibility of the electrodeposition of In-Sn alloys was examined.

EMIC (1-ethyl-3-methylimidazolium chloride) was purified according to the method in previous paper [1]. EMIC and $NaBF_4$ were weighed so as to be 60:40 mol% in a glove box and were then mixed in a sealed glass tube. After the tube had been kept at 373 K for five days, the NaCl precipitate was filtrated and was separated from the liquid phase. The obtained melt was dried under vacuum at 373 K for 24 hours. $InCl_3$ and/or $SnCl_2$ were added into the melt. A conventional three-electrode cell was used for all experiments, in which the working electrodes were a Pyrex glass shrouded platinum wire for voltammetry and a platinum flag for potentiostatic electrolysis.

Figure 1 shows the cyclic voltammogram of the EMI-BF_4-Cl melt containing 0.1 mol/kg $InCl_3$ and 0.1 mol/kg $SnCl_2$. Two reduction waves A and B were observed on the cathodic scan from the rest potential, and three oxidation waves C, D, and E appeared on the reverse scan. Comparing the result with the cyclic voltammograms measured in the melts separately containing of $InCl_3$ or $SnCl_2$ indicated that wave A corresponded to tin deposition, while wave B was located in the potential region for indium deposition. On the other hand, three oxidation waves observed on the reverse scan suggested the possibility of the electrodeposition of In-Sn alloy. In this paper, the results obtained by potentiostatic electrolysis in the melt followed by XRD and XPS analysis of the cathode surface will be shown to discuss the possibility of In-Sn alloy deposition.

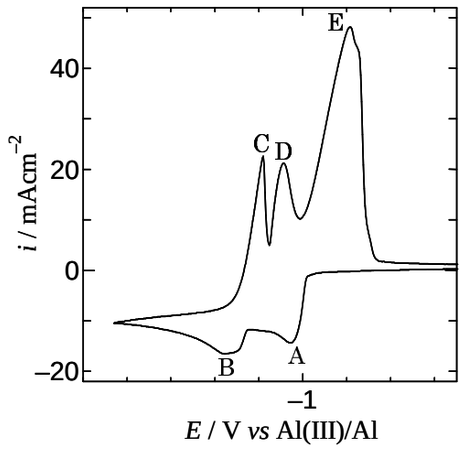

Fig. 1 Cyclic voltammogram of the EMI-BF_4-Cl melt with 0.1 mol/kg $InCl_3$ and $SnCl_2$ on Pt electrode at 10 mV/s at 353 K.

Reference

1. M. Morimitsu, Y. Nakahara, Y. Iwaki, M. Matsunaga, *J. Mining Metallurgy B*, **39**, 59 (2003).