

Cyclic Voltammetry Depending on the Electrode Connection Mode in Small-scale LCC Electrowinning System

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1. Introduction

LCC electrowinning system is composed of electrodes (anode, cathode, reference), salt stirrer, SUS (stainless steel) vessel containing salt, SUS lid and SUS LCC assembly [1,2]. The liquid Cd cathode (LCC) is loaded to the salt using LCC assembly. Although currents should flow only between anode and cathode in the salt, the SUS components and electrodes can be electrically connected each other through the electrolytic salt. In this study, cyclic voltammetry behavior at the above-mentioned electrowinning system was observed depending on the electrode connection mode of potentiostat to suggest desirable connection mode.

2. Experimental

Fig. 1 shows the typical electrowinning system, where glassy carbon anode, tungsten cathode, Ag/AgCl reference electrode and stirrer are electrically insulated from the above-mentioned SUS components but SUS LCC assembly can be electrically connected to the SUS lid. The diameter of tungsten cathode is 1 mm and the dipping depth into the salt is 5 ~ 10 mm. Potentiostat made by Bio-Logic Company was used to check the effect on the CV behavior depending on the electrode connection mode. The used salt is the mixture of LiCl-KCl, UCl_3 , $NdCl_3$, $CeCl_3$, $LaCl_3$ and YCl_3 .

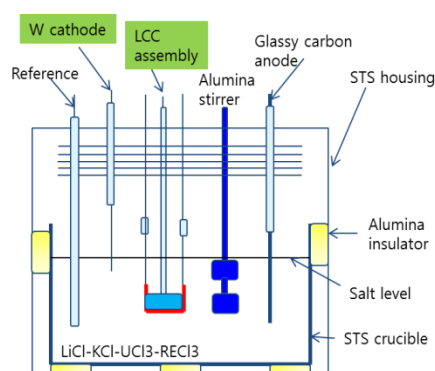


Fig. 1. Schematic diagram of LCC electrowinning system.

Fig. 2 shows the general electrode connection modes of potentiostat system. In the standard mode, a working electrode cable of potentiostat is connected to the working electrode of the cell and a counter cable to counter electrode. In the CE to ground mode, counter electrode cable of potentiostat is connected to the working electrode of the cell and ground cable to counter electrode.

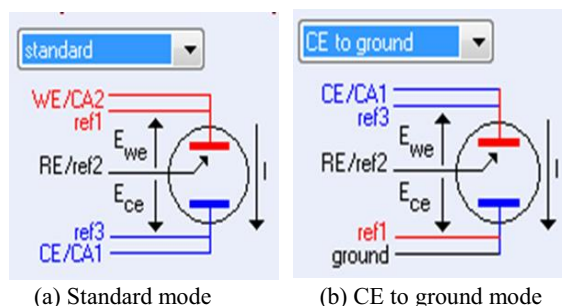


Fig. 2. Electrode connection mode of potentiostat system.

3. Results and Discussion

The behavior of cyclic voltammetry was compared depending on the electrode connection mode in the electrowinning system shown in Fig. 1.

3.1 Standard mode

Multi tab has normally 3 lines composed of 2 power lines and 1 ground line. The multi tab having 3 lines supplies current to potentiostat. Fig. 3 shows the cyclic voltammogram when using 3 line multi tab.

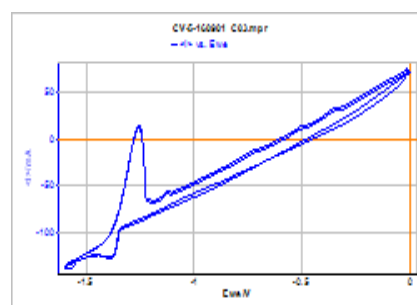


Fig. 3. Cyclic voltammogram at grounded standard mode.

Another multi tab without ground line is prepared to compare the CV behavior. Fig. 4 shows the cyclic voltammogram at the same electrowinning system when using the multi tab without ground line (ungrounded standard mode).

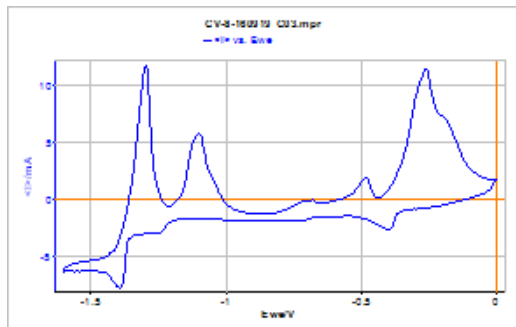


Fig. 4. Cyclic voltammogram at ungrounded standard mode.

Current values are lower when using the multi tab having 2 power lines than 3 lines. When considering the area of the tungsten cathode, current values of the ungrounded standard mode seem to be reasonable.

3.2 CE to ground mode

Fig. 5 shows the CV at the CE to ground mode. The multi tab having normal 3 lines was used for this measurement. Current values in Fig. 5 also look more reasonable than those in Fig. 3. But, in this connection mode, SUS parts connected to the ground line can be electrically connected to the anode and thereby SUS parts contacting the salt can be oxidized.

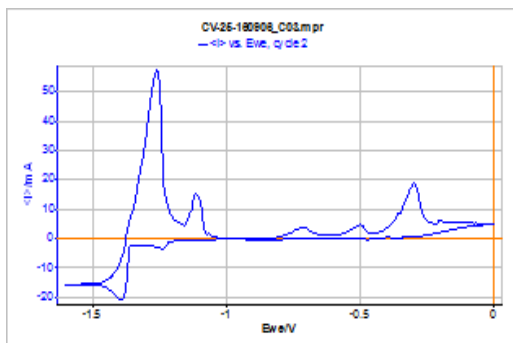


Fig. 5. Cyclic voltammogram at CE to ground mode.

4. Summary

In this paper, CV behavior of electrowinning system was studied depending on the electrode connection mode of potentiostat. In this system, currents can be flown from electrodes to SUS parts because the LCC assembly was electrically connected between the SUS parts and electrolytic salt. Standard mode without ground line of multi tab or CE to ground mode is considered to be more reasonable than standard mode when using multi tab having ground line.

REFERENCES

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