

## Recovery of U/Nd by LCC Electrodeposition and Cd Distillation Process

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### 1. Introduction

Pyroprocessing consists of pretreatment, electroreduction, electrorefining and electrowinning. SFR fuel is prepared from the electrowinning process which is composed of LCC (Liquid Cadmium Process) and Cd distillation et al. LCC is an electrochemical process to recover actinides from spent fuel [1,2]. Cd distillation process [3] is to remove the Cd from the LCC product (U/TRU/RE/Cd mixture) at the condition of high temperature and vacuum. In this study, U recovery was conducted using LCC and Cd distillation.

### 2. Methods and Results

#### 2.1 Experimental procedures

LiCl-KCl-UCl<sub>3</sub>-NdCl<sub>3</sub> salt was contained in an alumina electrolytic crucible having an inner diameter of 5cm. Three kinds of electrodes such as cathode, anode, reference were used for this study. Both solid tungsten (W) and LCC were used as cathodes. W cathode was utilized to check the change of the U/Nd concentration in the salt by CV (cyclic voltammetry) method. Liquid Cd of 47g as the cathode material was contained in alumina crucibles for the deposition experiments by CP (chronopotentiometry) method, where the crucible has an inner diameter of 3cm. Cd contained in an LCC alumina crucible was melted at 500°C and then used as a cathode. Glassy carbon rod with the diameter of 0.3cm was employed as an anode. A pyrex tube containing LiCl-KCl-1mol%AgCl and silver (Ag) wire having a diameter of 1mm was used as a reference electrode. Chronopotentiogram was obtained at 500°C at a current density of 50 mA/cm<sup>2</sup>.

Cd distillation was conducted to obtain U/Nd metal from the LCC deposit composed of U/Nd/Cd elements. Distillation behavior was observed through the heating to 1200°C in a vacuum condition. Not only LCC electrodeposition but also Cd distillation was conducted in a glove box to maintain low oxygen and moisture contents.

#### 2.2 Results

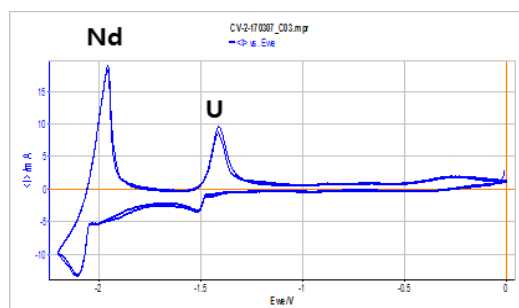


Fig. 1 Cyclic voltammogram of the initial salt composition.

Fig. 1 shows the presence of U/Nd elements in the salt. Peak potentials of U and Nd were positioned at around -1.4 and -2.1V, respectively. No other peaks except U and Nd were seen in Fig. 1, which shows no impurities in the initial salt.

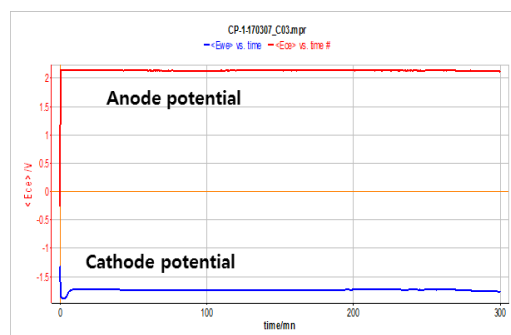


Fig. 2 Chronopotentiogram of U/Nd at the current density of 50mA/cm<sup>2</sup> at 500°C.

Fig. 2 shows the variations of the anode and cathode potential at the current density of 50 mA/cm<sup>2</sup> at 500°C for 5 hours in LiCl-KCl-UCl<sub>3</sub>-NdCl<sub>3</sub> salt. During the electrodeposition, anode and cathode potential were stably maintained at around 2.14V and -1.74V, respectively. Chlorine gas (Cl<sub>2</sub>) would be evolved on the surface of glassy carbon anode and deposition of U/Nd happened on the LCC. So, the amount of U and Nd in the salt becomes more and more decreased as the deposition proceeds. After the deposition, the alumina crucible was lifted above the electrolytic container and visually examined to check whether U dendrite grew out of the LCC alumina crucible or not. Some of the U deposit was mounted on the edge of the LCC crucible.

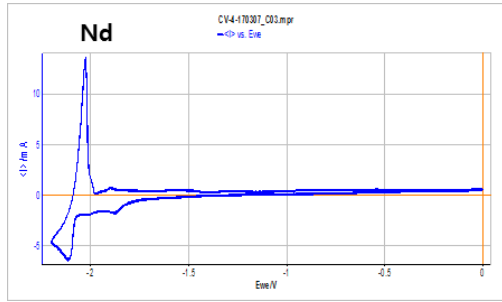
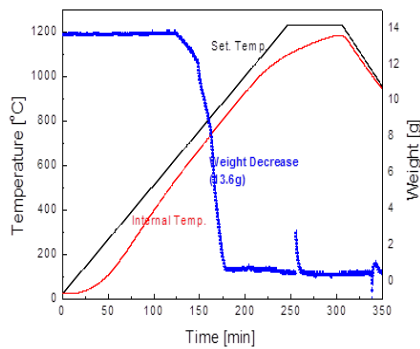
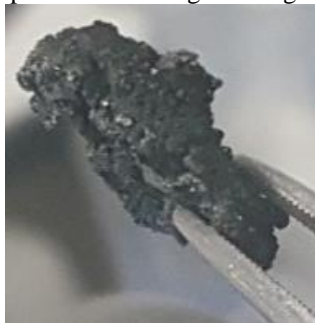


Fig. 3 Cyclic voltammogram of the salt composition after the electrodeposition.

Fig. 3 shows the change of U/Nd elements in the salt after electrodeposition. U peak disappeared and only Nd peak was observed. It shows the most of the U was deposited into the LCC.



(a) Temperature and weight during the distillation



(b) U/RE element

Fig. 4 Distillation process (upper) and U/RE element after the distillation (lower).

Fig. 4 shows the result of distillation process conducted for this study. It is thought that most of the Cd elements were removed from the U/Nd/Cd product after the distillation at 1200°C. Fig. 4(b) shows the U/Nd metal after the distillation.

### 3. Conclusions

U/Nd recovery process was carried out by LCC electrodeposition and Cd distillation process. During the

electrodeposition, most of the U in the salt was deposited onto the LCC including minor Nd element. U/Nd/Cd produced from the electrodeposition was heated to 1200°C in vacuum atmosphere. U/Nd element was successfully obtained after the Cd distillation.

### Acknowledgement

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