

Recovery of Uranium from Uranium and Lanthanides in LiCl-KCl molten salt by electrowinning including Cd-Li anode

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1. INTRODUCTION

A trans-uranium (TRU) fuel should be manufactured and loaded in transmutation systems in order to transmute the long-lived TRU nuclides into short-lived ones. However, since all of the TRU nuclides are not completely transmuted in one cycle lifetime in transmutation systems, the spent TRU fuel has to be treated to recover the long-lived radionuclides or fuel matrix materials. One concept to manufacture TRU fuel for transmutation is to recover uranium from TRU and molten salt. If this type of fuel is adopted for transmutation, uranium could also be an objective material to be recovered and recycled. Since electrowinning is a promising technology to be employed for the recovery of uranium from fuel materials, some experimental work of electrowinning using anode of Cd-Li alloy was carried out in this study. The basic salt chosen was a mixture of LiCl-KCl which has an eutectic point at 357 °C.

2. EXPERIMENTAL

The Electrowinning equipment used in this work is shown in Fig.1. It consists of a muffle furnace, reactor, argon gas supplying system, effluent gas collecting system, vacuum pump, the personal computer system and recorder. Molten salt in nickel crucible was mixed by agitator. And argon gas was supplied into reactor in order to control argon atmosphere in reactor. The eutectic salt LiCl-KCl (59-41 mol %) was prepared, 250.14g per batch, at 500 °C. Cd-Li (94-6wt%) alloy prepared in order to use anode materials, 304.54g per batch, at 450, 600, 700 °C. Reactor for preparation of Cd-Li alloy used graphite and alumina vessel. Recovery experiments of uranium from molten salt was carried

electrowinning by using Cd-Li anode and solid cathode at 500 °C. The experimental conditions was that ratio of U to Li contents were 1: 0.5,1:1,1:1.5. Composition in eutectic salt are shown table 1. Sampling time in reactor is 0, 3, 5hrs. The chemical analyses were done by using a AAS, ICP.

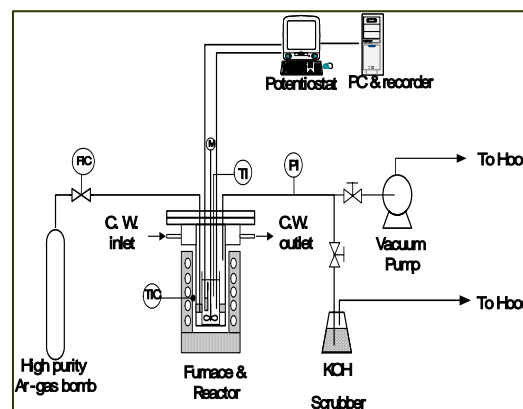


Fig.1 Schematic diagram of apparatus

Table 1. Components and reagents

LiCl	KCl	U	CdCl ₂	DyCl ₃	CeCl ₃	YCl ₃	NdCl ₃	GdCl ₃
112.5g	137.6g	6.67g	7.62g	9.67g	1.12g	0.23g	0.98g	0.034g

3. RESULTS AND DISCUSSION

The results of experiment for preparation of Cd-Li alloy at 700 °C was broken alumina vessel because of thermal shock, but graphite vessel did not broken in same condition.

In the Cd-Li alloy preparation experiments, Li content of Cd-Li alloy was 3.6 wt% less than initial

Li content(6wt%), because of deposition on surface of reactor. The results of the experimental for electrowinning are as follows: (As shown Fig. 2, 3, 4) Recovery of uranium at Li ratio is 0.5, only uranium was recovery from salt. But at Li ratio is 1.0, 1.5, uranium with others elements was recovery from multi components in molten salt reacted for 3 hours at -1.0 volt, 550 . In this experimental condition, reaction of uranium with lithium is dominant chemical reaction more than electrochemical reaction because of current density of anode is low.1)

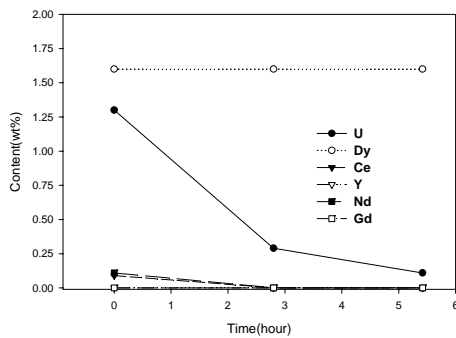


Fig.2 Contents of elements with reaction time at U:Li ratio:0.5, -1.0 volt, 500 .

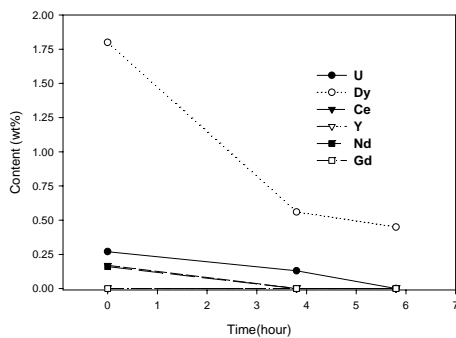


Fig.3 Contents of elements with reaction time at U:Li ratio:1.0, -1.0 volt, 500 .

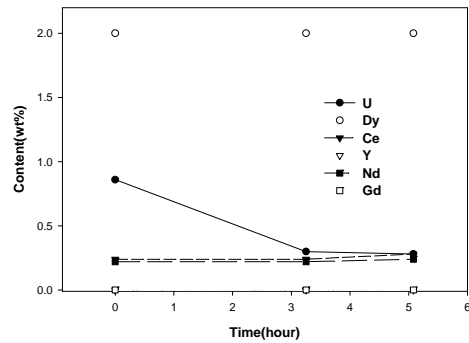


Fig.4 Contents of elements with reaction time at U:Li ratio:1.5, -1.0 volt, 500 .

4. CONCLUSION

The fundamental experimental results obtained in this study show that graphite vessel for preparation of Cd-Li alloy is better than alumina. And Lithium content in Cd-Li alloy is lower than initial, because of deposition on surface of vessel. At selectively recovery of uranium from multi-component in molten salt by electrowinning, reaction of uranium and lithium is electrochemical reaction together with chemical reaction. In addition, it may be required to do more study in order to completely develop the uranium recovery process by electrowinning including Cd-Li anode.

REFERENCES

[1] Y.H. kang, etal, KAERI/TS-110/99, pp 79, 1999.