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種別(和文)	論文要旨
Type(English)	Summary

（博士課程）
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論 文 要 旨

THESIS SUMMARY

専攻： Department of	原子核工学 専攻	申請学位（専攻分野）： Academic Degree Requested	博士 （工学） Doctor of
学生氏名： Student's Name	森 貴宏	指導教員（主）： Academic Advisor(main)	鷹尾康一朗
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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

From the start of commercial use of nuclear power, huge amount of radioactive wastes have been discharged in each stage of a nuclear fuel cycle. Especially, uranium contaminated steel materials and sludge are discharged as "uranium waste" from the frontend of the cycle. To reduce the volume of these uranium wastes and for recovery of uranium, development of decontamination methods are eagerly required. Although several decontamination methods such as solvent extraction, adsorption and precipitation have been proposed, these methods usually need to use of flammable materials (e.g. organic solvents or resins) which can be causes of conflagrations. The fundamental feasibility of an U(VI) separation and recovery method using betainium-type ionic liquid (IL) which has thermal stability, non-flammability and negligibly low vapor pressure was studied. The extraction chemistry of U(VI) by using betainium-type IL was mainly focused on since it is the most important part of the present method. This doctoral thesis consists of eight chapters as described below.

Ch. 1, the background of this thesis was introduced. The priority of chemical decontamination of the uranium wastes was mentioned by comparing with other methods. The protocol of the decontamination process using betainium-type IL was proposed. It was mentioned that the objective of this thesis is to investigate the fundamental chemical aspects in the separation and recovery method of uranium from the uranium wastes using betainium-type IL.

Ch. 2, extraction behavior of U(VI) in the [HGbet][Tf_2N]–water system was investigated. The distribution ratio of U(VI) decreased with an increase in acid concentration of the aqueous phase. The formation of $[UO_2(Gbet)_n]^{2+}$ was assumed as an extractable species, which supported by optical spectroscopy and DFT calculations. The formation of $[UO_2(Gbet)_2]^{2+}$ followed by its coextraction with $3[Tf_2N]^-$ and $[HGbet]^+$ were proposed as an extraction mechanism.

Ch. 3, four novel betainium-type ILs ($[Tf_2N]^-$ salt of $[HAbet]^+$, $[HVbet]^+$, $[HLbet]^+$ and $[HIbet]^+$) were synthesized and characterized by ^1H and ^{13}C NMR. Physical properties of these ILs such as viscosity, p*K*a and water contents were measured. The *n*-octanol / water partitioning coefficient (log P_{ow}) was evaluated as the criterion of hydrophobicity. As a result, it was revealed that the order of hydrophobicity follows [Gbet][Tf_2N] < [HAbet][Tf_2N] < [HVbet][Tf_2N] < [HLbet][Tf_2N] < [HIbet][Tf_2N]. Especially log P_{ow} of [HLbet][Tf_2N] and [HIbet][Tf_2N] (1.4 and 1.8, respectively) is very high compared with that of [HGbet][Tf_2N] (-0.54).

Ch. 4, extraction behavior of U(VI) in the [HGbet][Tf_2N], [HAbet][Tf_2N], [HVbet][Tf_2N], [HLbet][Tf_2N] and [HIbet][Tf_2N]-water system was studied. The extraction equilibrium was found to rapidly attain except for the [HIbet][Tf_2N] system, where the extractability gradually increases with the elapse of time, taking more than 2 h. Because the rate of extraction was depend on the concentration of $[HXbet]^+$ (X = G, A, V, L and I) in the aqueous phase, the rate-determining step may be complexation of $[UO_2(Xbet)_n]^{2+}$. From the result of slope analysis of pH - log*D* plots (slope ≈ 2), extracted complex was regarded as $[UO_2(Xbet)_2]^{2+}$.

Ch 5, selective extraction of U(VI) was tested under contamination of Na(I), Ca(II), Al(III), Fe(II), Co(II) and Ni(II). All [HXbet][Tf_2N] showed high selectivity for U(VI) compared with other metal ions. [HVbet][Tf_2N], [HLbet][Tf_2N] and [HIbet][Tf_2N] extracted 90% of U(VI) while [HGbet][Tf_2N] and [HAbet][Tf_2N] extracted up to 50 - 70%.

Ch 6, recovery of U(VI) from [HXbet][Tf_2N] and recycle of [HXbet][Tf_2N] were conducted. U(VI) was recovered from [HXbet][Tf_2N] by adding 30 wt% H_2O_2, and the recovery ratio was more than 90% in all [HXbet][Tf_2N]. To ascertain the recyclability of [HXbet][Tf_2N], the extraction-recovery cycle was repeated three times in each [HXbet][Tf_2N]. As a result, the higher hydrophobicity of [HXbet][Tf_2N] gives the higher recyclability of themselves.

Ch. 7, the dissolution behavior of uranium oxides in the [HGbet][Tf_2N] was studied. Adding HNO_3 or [HGbet][NO_3] as an oxidant, U_3O_8 was completely dissolved at 90ºC. [HGbet][NO_3] should be preferable in terms of subsequent back extraction process. Although dissolution ratio of UO_2 increased by adding [HGbet][NO_3], it was up to 10% even at 90ºC and 2h.

Ch 8, all the results were summarized. It was concluded that the novel highly hydrophobic betainium-type ILs are useful for decontamination of the uranium wastes from perspectives of thermal stability, extractability, selectivity and recyclability.

備考 ： 論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。
Note : Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1copy of 800 Words (English).
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