

Supporting Information for:

Kinetic Study and Process Optimization of Plutonium Barrier Units for Enhanced Plutonium Stripping in the PUREX Process

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S1. Experimental

The simulation was carried out by the plutonium barrier process simulation programme developed by the China Institute of Atomic Energy (CIAE), with the following interface:



Figure S1. The graphic interface for I/O of parameter

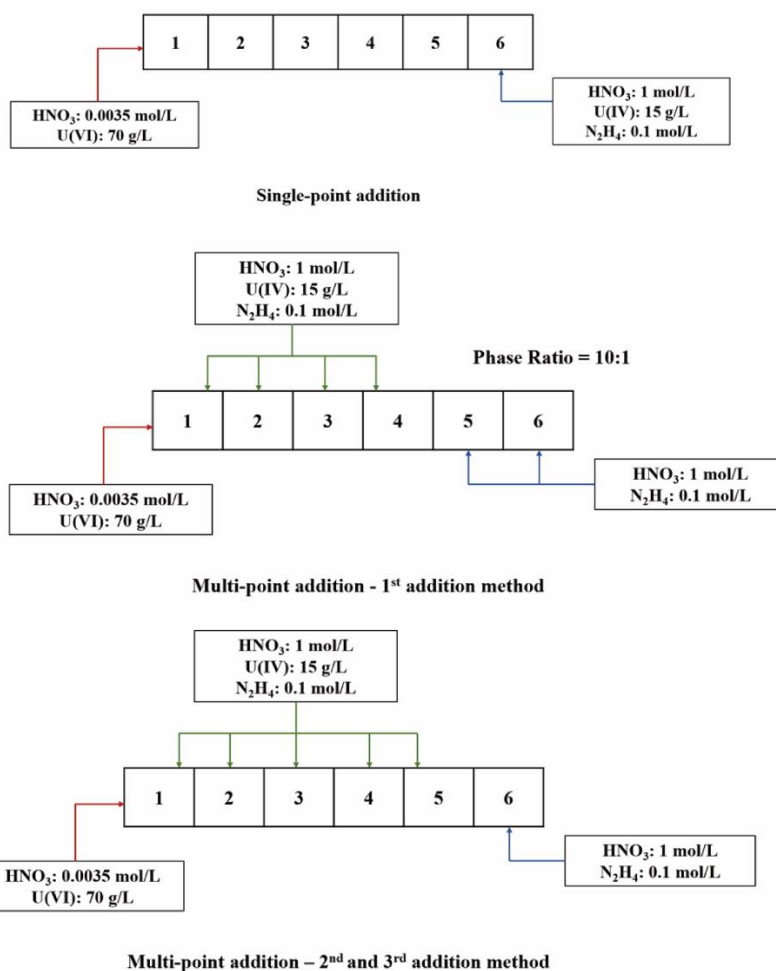


Figure S2. Various addition model and parameter diagram

S2. Results

S2.1 U(IV) extraction losses study

In the first addition model, by varying the proportion of the organic phase to the total aqueous phase flux in the six stages (1BXX1-1BXX6), and at the same time keeping the total U(IV) addition constant by adjusting the U(IV) concentration added to the first four stages, the distribution of U(IV) among the stages was calculated, as shown in Table S1.

Table S1. Flow ratio of the first addition model

Addition Model	Stage Number Times	1	2	3	4	5	6
1 st	1					0.25	0.25
	2					0.5	0.5
	3					1.0	1.0
	4	0.25	0.25	0.25	0.25	1.5	1.5
	5					2.0	2.0
	6					2.5	2.5
	7					3.0	3.0

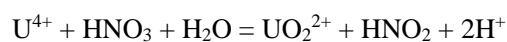
In the second addition model, changing the proportion of 1BXX6 to the total aqueous phase flux, the other simulation conditions were the same as the first addition, as shown in Table S2.

Table S2. Flow ratio of the first addition model

Addition Model	Stage Number Times	1	2	3	4	5	6
2 nd	1						0.5
	2						1.0
	3						2.0
	4	0.2	0.2	0.2	0.2	0.2	3.0
	5						4.0
	6						5.0
	7						6.0

S2.2 Study on Oxidative loss of U(IV)

In HNO₃ media, U(IV) may be oxidised by HNO₂, O₂, however in 1BXX unit, the HNO₃ media contains an excess of the holding reducing agent hydrazine, so that the HNO₂ content of the HNO₃ media is extremely low, and there is little oxidation of U(IV). The oxidation reaction is as follows:



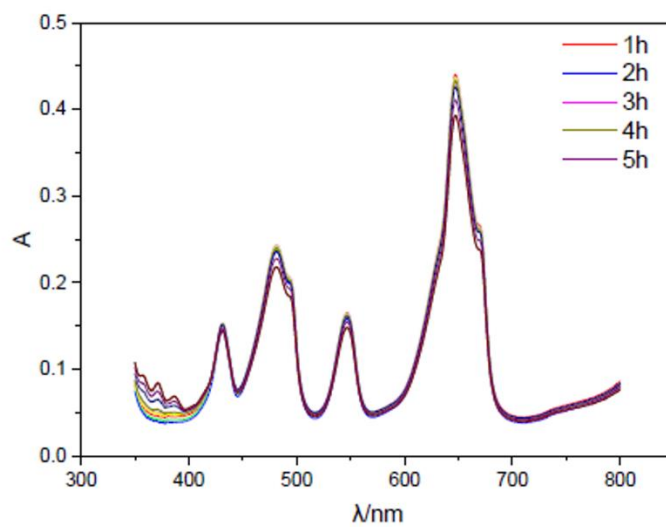
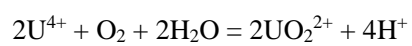


Figure S3. Spectrogram of U(IV) in nitric acid.

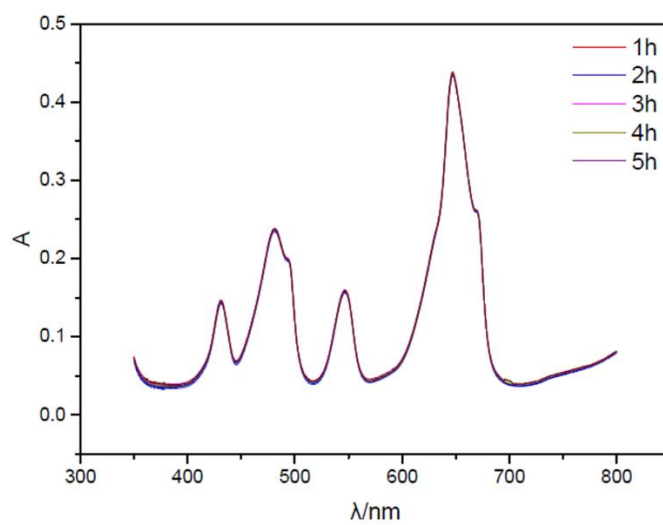


Figure S4. Spectrogram of U(IV) in perchloric acid.

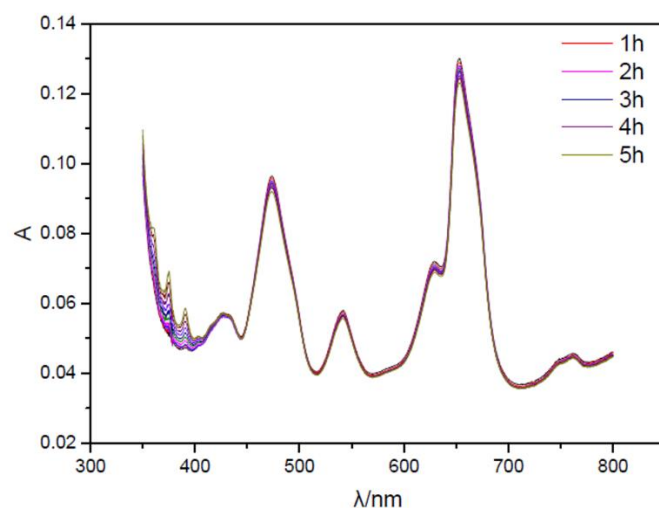


Figure S5. Spectrogram of U(IV) in 30%TBP.

Table S3. The oxidation of U(IV) in organic phase at single point addition

Temperature (°C)	1 st stage	2 nd stage	3 rd stage	4 th stage	5 th stage	6 th stage	Oxidation Capacity
25	0.0356	0.0703	0.0900	0.0910	0.0803	0.0492	2.78%
30	0.0699	0.1385	0.1777	0.1797	0.1588	0.0974	5.48%
35	0.1338	0.2664	0.3425	0.3467	0.3067	0.1884	10.56%

Table S4. The oxidation of U(IV) in organic phase with the third addition model.

Temperature (°C)	1 st stage	2 nd stage	3 rd stage	4 th stage	5 th stage	6 th stage	Oxidation Capacity
25	0.0104	0.0190	0.0306	0.0497	0.0867	0.1889	2.57%
30	0.0203	0.0373	0.0601	0.0981	0.1714	0.3741	5.08%
35	0.0386	0.0713	0.1155	0.1890	0.3311	0.7237	9.79%