

## Electronic Supplementary Information

### Catalytic decomposition of hydrazine nitrate and hydroxylamine nitrate in radioactive nitric acid waste liquid using Ru/AC catalyst

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### List of Contents

(1) Determination of HAN concentration	S2
(2) Determination of HN concentration	S3
(3) The influence of catalyst dosage on the reaction time for the complete decomposition of HAN and HN	S4
(4) The influence of reaction temperature on the reaction time for the complete decomposition of HAN and HN	S5
(5) The influence of HNO <sub>3</sub> concentration on the reaction time for the complete decomposition of HAN and HN	S6
(6) The influence of HAN concentration on the reaction time for the complete decomposition of HAN and HN	S7
(7) The influence of HN concentration on the reaction time for the complete decomposition of HAN and HN	S8

### (1) Determination of HAN concentration

The concentration of HAN was determined using ultraviolet-visible spectrophotometry. The hydroxylamine exhibits the ability to effectively reduce  $\text{Fe}^{3+}$  ions to  $\text{Fe}^{2+}$  ions in solution. In a pH range of 2-9, o-phenanthrene undergoes a colour reaction with  $\text{Fe}^{2+}$  ions. This reaction demonstrates remarkable selectivity and yields a highly stable orange-red complex, exhibiting maximum absorption at 510 nm (as depicted in Fig. S1). In the range of  $10^{-4}$ - $10^{-3}$  mol/L, the standard curve of HAN concentration and absorbance are shown in Fig. S2. By utilizing this colour reaction, trace amounts of HAN can be accurately quantified through spectrophotometry.

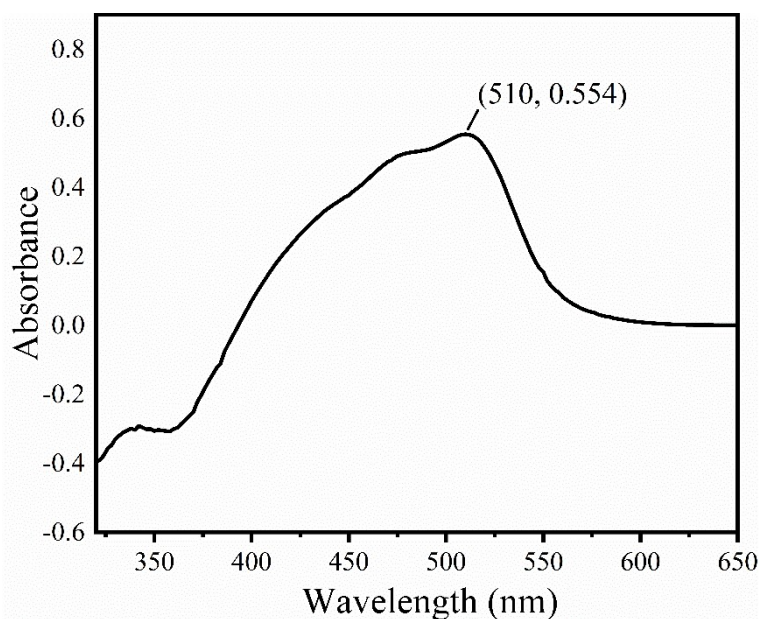


Fig. S1 Full spectrum scan image of HAN color reaction absorbance.

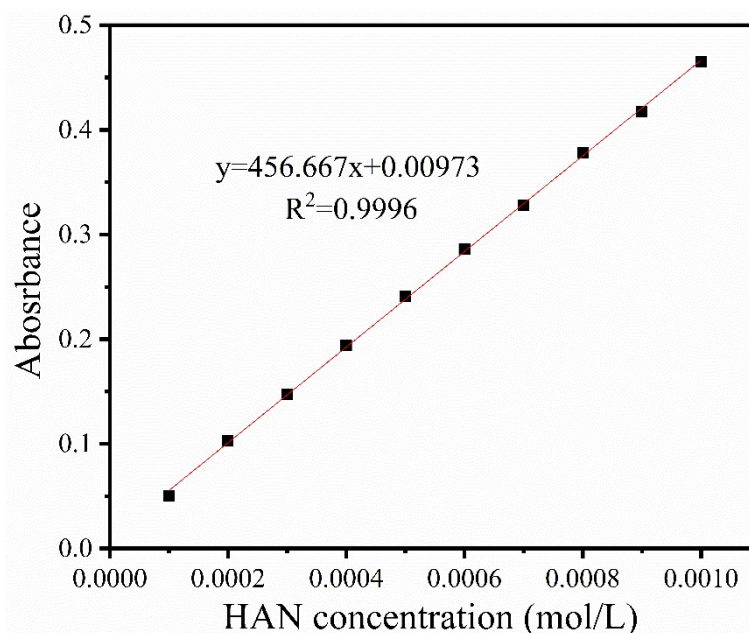


Fig. S2 The standard curve of HAN concentration and absorbance.

## (2) Determination of HN concentration

The concentration of HN was determined using ultraviolet-visible spectrophotometry. Under acidic conditions, hydrazine undergoes a colour reaction with p-dimethylaminobenzaldehyde. The maximum absorbance was measured at 457 nm, as depicted in Fig. S3. And the concentration of hydrazine exhibits proportionality to the measured absorbance within a specific range. In the range of  $10^{-4}$ - $10^{-3}$  mol/L, the standard curve of HN concentration and absorbance are shown in Fig. S4. By utilizing this colour reaction, trace amounts of HN can be accurately quantified through spectrophotometry.

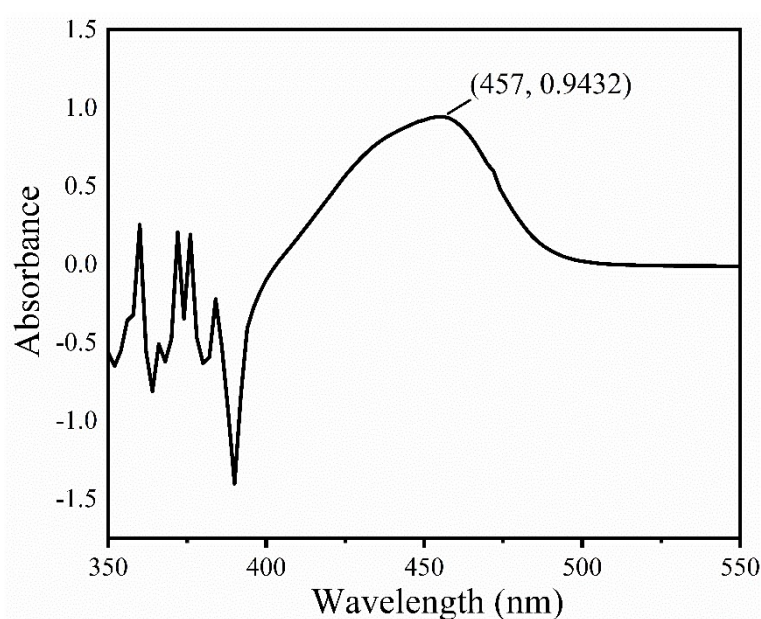


Fig. S3 Full spectrum scan image of HN color reaction absorbance.

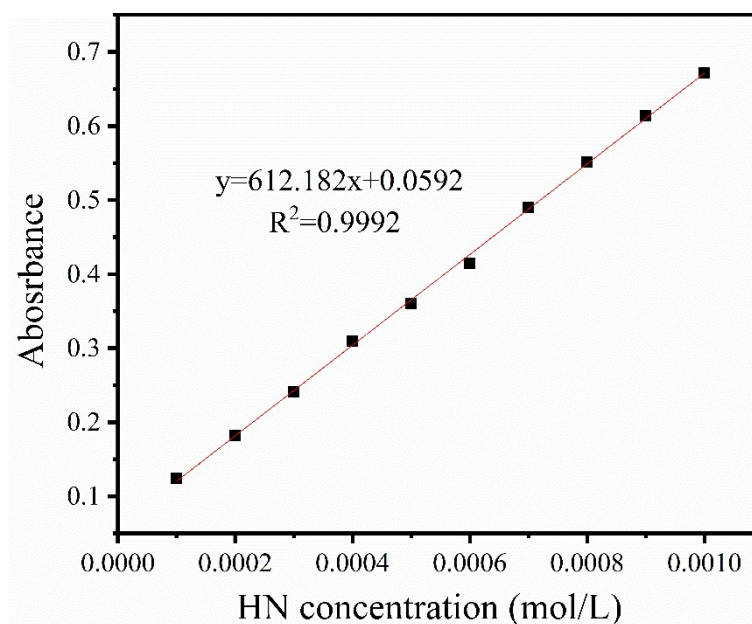


Fig. S4 The standard curve of HN concentration and absorbance.

**(3) The influence of catalyst dosage on the reaction time for the complete decomposition of HAN and HN**

Table S1 The influence of catalyst dosage on the reaction time for the complete decomposition of HAN and HN

Entry	Catalyst dosage (g)	Reaction time (min)	HAN decomposition rate (%)	HN decomposition rate (%)
1	0.5	10	2.59	14.15
		30	31.63	56.13
		50	51.01	81.19
		70	70.54	96.47
		90	99.99	99.99
2	1.5	10	11.85	44.85
		30	51.59	80.94
		50	83.47	98.26
		55	99.99	99.99
3	2.5	5	8.34	26.81
		15	43.99	78.85
		25	75.15	96.33
		35	99.99	99.99
4	3.5	10	33.66	70.28
		20	72.21	95.41
		29	99.99	99.99
5	5.0	5	24.96	43.19
		15	73.31	96.47

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	25	99.99	99.99
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**(4) The influence of reaction temperature on the reaction time for the complete decomposition of HAN and HN**

Table S2 The influence of reaction temperature on the reaction time for the complete decomposition of HAN and HN

Entry	Temperature (°C)	Reaction time (min)	HAN decomposition rate (%)	HN decomposition rate (%)
1	60	10	5.08	8.12
		40	30.71	56.77
		70	55.42	83.92
		100	72.53	96.08
		120	99.99	99.99
2	70	10	7.00	20.57
		30	40.05	63.84
		50	62.23	90.56
		80	99.99	99.99
3	80	5	8.34	26.81
		15	43.99	78.85
		25	75.15	96.33
		35	99.99	99.99
4	90	10	30.80	55.63
		20	60.95	96.36
		30	99.99	99.99

**(5) The influence of HNO<sub>3</sub> concentration on the reaction time for the complete decomposition of HAN and HN**

Table S3 The influence of HNO<sub>3</sub> concentration on the reaction time for the complete decomposition of HAN and HN

Entry	HNO <sub>3</sub> concentration (mol/L)	Reaction time (min)	HAN decomposition rate (%)	HN decomposition rate (%)
1	0.8	10	21.12	51.87
		20	49.38	85.87
		30	74.09	98.26
		40	91.34	99.91
		45	99.99	99.99
2	1.0	5	8.34	26.81
		15	43.99	78.85
		25	75.15	96.33
		35	99.99	99.99
3	1.2	5	9.16	27.78
		15	46.36	83.48
		25	77.97	97.29
4	1.4	33	99.99	99.99
		5	11.21	29.98
		15	55.06	86.14
5	1.6	25	89.35	99.63
		28	99.99	99.99
		5	13.58	31.12
5	1.6	15	57.83	88.35
		25	99.99	99.99

**(6) The influence of HAN concentration on the reaction time for the complete decomposition of HAN and HN**

Table S4 The influence of HAN concentration on the reaction time for the complete decomposition of HAN and HN

Entry	HAN concentration (mol/L)	Reaction time (min)	HAN decomposition rate (%)	HN decomposition rate (%)
1	0.1	11	28.01	65.63
		20	54.64	88.89
		30	78.07	99.35
		38	99.99	99.99
2	0.2	5	2.45	23.09
		15	40.90	76.23
		25	69.76	97.57
		36	99.99	99.99
3	0.3	5	8.34	26.81
		15	43.99	78.85
		25	75.15	96.33
		35	99.99	99.99
4	0.4	8	15.28	42.49
		15	40.79	78.31
		25	73.43	98.73
		35	99.99	99.99
5	0.5	5	4.67	27.82
		15	42.37	82.29
		25	74.36	99.05
		34	99.99	99.99



**(7) The influence of HN concentration on the reaction time for the complete decomposition of HAN and HN**

Table S5 The influence of HN concentration on the reaction time for the complete decomposition of HAN and HN

Entry	HN concentration (mol/L)	Reaction time (min)	HAN decomposition rate (%)	HN decomposition rate (%)
1	0.06	6	25.24	54.65
		10	42.42	77.37
		18	88.22	98.93
		24	99.99	99.99
2	0.08	5	10.19	32.60
		15	54.49	88.01
		25	88.57	99.20
3	0.10	30	99.99	99.99
		5	8.34	26.81
		15	43.99	78.85
		25	75.15	96.33
4	0.12	35	99.99	99.99
		5	5.79	28.00
		15	35.61	72.97
		30	78.21	96.71
5	0.14	47	99.99	99.99
		10	9.91	39.76
		30	39.44	79.88
		50	66.85	96.79
		74	99.99	99.99