

## Supporting information

### Text S1. Chemical reagents

Chemical solutions were meticulously prepared using reagent-grade deionized water with a resistivity of 18.2 mΩ/cm, obtained through the utilization of a Milli-Q Reference system (Merck KGaA, Darmstadt, Germany). Pyridine (PYD) (99.5%), N, N-dimethylformamide (DMF) (HPLC) were supplied by Meryer, Shanghai (China), and acrylonitrile (AN) (99%) was purchased from Energy Chemical, Anhui (China). Sodium dihydrogen phosphate (NaH<sub>2</sub>PO<sub>4</sub>) (GR), sodium dihydrogen phosphate (Na<sub>2</sub>HPO<sub>4</sub>) (GR), uridine (98%), phenyl isothiocyanate (PITC) (99%), salicylate acid and sodium hydroxide (NaOH) (97%) were procured from heowns, Tianjin (China). Hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) (>30%), Nash reagent (99.8%) and dimethylamine (DMA) solutions (40%) were obtained from Aladdin, Shanghai (China). Phosphoric acid (H<sub>3</sub>PO<sub>4</sub>) (GR), acetonitrile (HPLC), methanol (HPLC), formaldehyde (37%–40%), and acetic acid (96%) were sourced from Kermel, Tianjin (China). Potassium persulfate (K<sub>2</sub>S<sub>2</sub>O<sub>8</sub>) (N<0.005%) was acquired from J&K Scientific, Beijing (China). *tert*-butanol (TBA) (99%) was supplied by TCI Chemical, Shanghai (China). n-hexane (AR) was purchased from Fengchuan Chemical, Tianjin (China). Triethylamine (AR) and methylamine (MA) aqueous solutions (AR) were procured from DAMAO, Tianjin (China). Peptidase (Product No: p984275; version: 2023-07-28; concentration: 2000 u/g) purchased from MACKLIN, Shanghai (China).

### Text S2. Light intensity of UV and VUV irradiation system

In our investigation, UV photo reactor with the light intensity of  $2.73 \times 10^{-6}$  Einstein/L/s was used to compare the error in the spectrophotometric method of Nessler reagent and salicylic acid hypochlorite. A VUV helical tube served as the photo reactor for degradation experiment. The VUV helical tube was found to have 0.011 Einstein/m<sup>2</sup>/s ( $2.57 \times 10^{-5}$  Einstein/L/s) at 185 nm and 0.0923 Einstein/m<sup>2</sup>/s ( $2.69 \times 10^{-4}$  Einstein/L/s) at 254 nm.

### Text S3. Calculation of *MDL* and *LOQ* when $n = 7$

For the standard curves based on derivation, we used the following equation for the calculation of *MDL* (Eq. (S1)).

$$MDL = t_{(n-1,0.99)} \times S \quad (S1)$$

where *MDL* is the method detection limit; *n* is the number of parallel measurements of the sample ( $n = 7$  in our research); *t* is the t-distribution (one-sided) with *n*-1 degrees of freedom and 99% confidence level; and *S* is the standard deviation of the *n* parallel measurements.

For the calculation of *LOQ*, the following equation were used. In short, the *LOQ* is 10 times the *MDL* (Eq. (S2)).

$$LOQ = 10 \times MDL \quad (S2)$$

**Table S1** Key reactions related to the reactive species in the VUV irradiation (Chen et al., 2019).

Radicals' generation and self-destruction		
$H_2O + hv_{185nm} \rightarrow \bullet OH + \bullet H$	$\Phi_{\bullet OH} = 0.33 \text{ einstein}^{-1}$	Reaction 1
$H_2O + hv_{185nm} \rightarrow \bullet OH + H^+ + e_{aq}^-$	$\Phi_{e_{aq}^-} = 0.045 \text{ einstein}^{-1}$	Reaction 2
$e_{aq}^- + O_2 \rightarrow \bullet O_2^-$	$K = 1 \times 10^{10} M^{-1} \cdot s^{-1}$	Reaction 3
$\bullet H + \bullet OH \rightarrow H_2O$	$K = 7 \times 10^9 M^{-1} \cdot s^{-1}$	Reaction 4
$e_{aq}^- + H^+ \rightarrow \bullet H$	$K = 2.3 \times 10^{10} M^{-1} \cdot s^{-1}$	Reaction 5
$e_{aq}^- + H_2O \rightarrow \bullet H + OH^-$	$K = 1.9 \times 10^1 M^{-1} \cdot s^{-1}$	Reaction 6

**Table S2** Gradient elution conditions for measured derivatives.

Time/min	C pump concentration as a percentage of/%
0.01	95
3.00	95
10.00	10
15.00	10
19.00	95
20.00	95

**Table S3** Comparison of the standard curve for  $\text{NH}_4^+$  of spectrophotometric methods of Nessler Reagent and Salicylic Acid Hypochlorite Spectrophotometry.

Standard (mg/L)	Nessler Reagent	Salicylic Acid Hypochlorite
$\text{NH}_4^+$	0.00	0.00
	0.10	0.10
	0.20	0.20
	0.40	0.41
	0.60	0.60
	0.80	0.79

**Table S4** Comparison of  $\text{NH}_4^+$  generation after 20 min reaction of PYD, DMF and AN (Initial concentration: 50  $\mu\text{mol/L}$ ) in  $\text{UV}/\text{H}_2\text{O}_2$  (0.1  $\text{mmol/L}$ ). (The conversion rate refers to the amount of  $\text{NH}_4^+$  generated as a percentage of the degraded target pollutant.)

Compounds	Conversion Rate		
	Salicylic Acid Hypochlorite	Nessler Reagent	Deriv-HPLC
PYD	54%	159%	37%
DMF	2%	103%	3%
AN	0%	123%	0%

**Table S5** Absorbance of salicylic acid hypochlorite spectrophotometry in the presence of DMA (22.5  $\text{mg/L}$ ) and MA (15.5  $\text{mg/L}$ ), respectively. (without  $\text{NH}_4^+$ ).

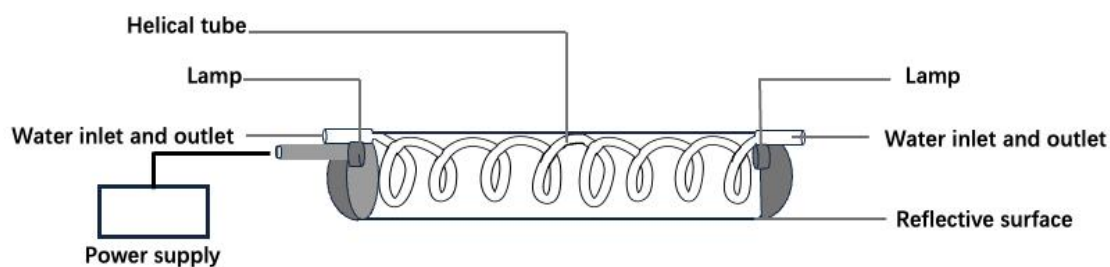
Parameter	DMA	MA
Abs	0.34	0.43

**Table S6** Correspondence between number of texts and peak areas of  $\text{NH}_4^+$ -, MA- and DMA-derivatives.

No. of text	Peak area		
	$\text{NH}_4^+$ -derivatives	MA-derivatives	DMA-derivatives
1	94515	54802	38931
2	92457	49428	38714
3	95016	52217	39669
4	96792	52823	41455
5	95929	49839	40618
6	95740	49359	39450
7	95936	51042	39961

**Table S7** *MDL* and *LOQ* of the HPLC tests for  $\text{NH}_4^+$ , MA and DMA.

Parameters	Concentration (mg/L)		
	$\text{NH}_4^+$	MA	DMA
<i>MDL</i>	0.02	0.02	0.02
<i>LOQ</i>	0.20	0.20	0.13

**Fig. S1** Experimental setup of VUV irradiation.

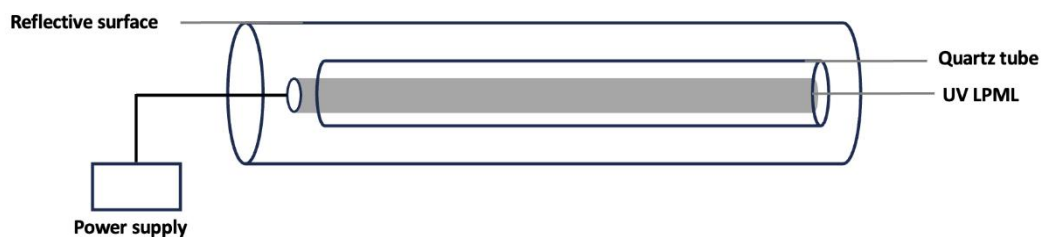


Fig. S2 Experimental setup of UV low-pressure mercury lamp (LPML).

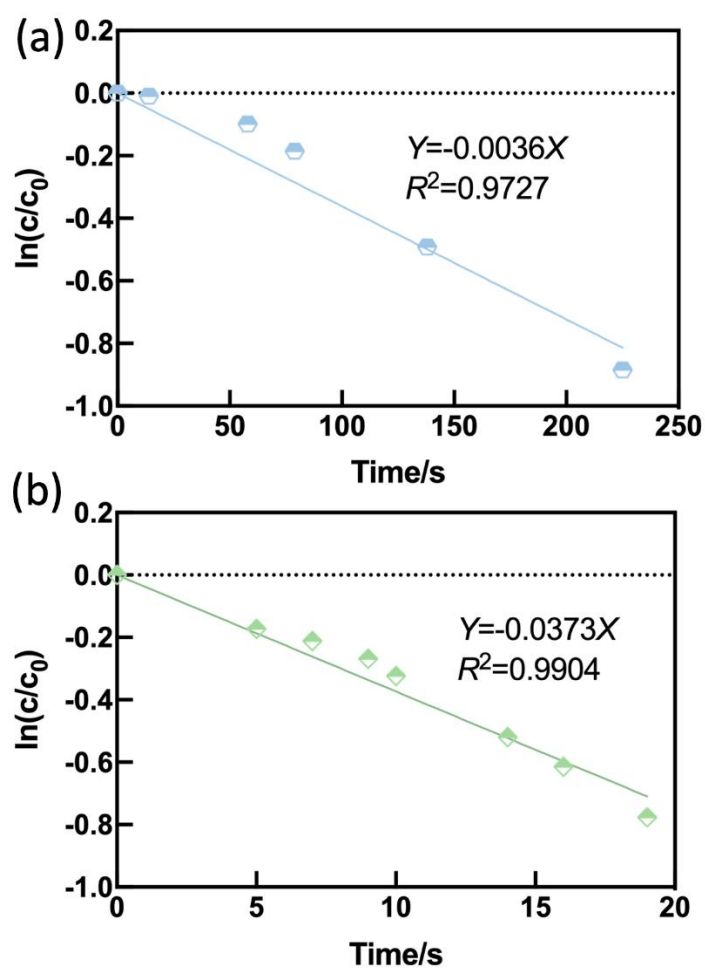


Fig. S3  $\ln(c/c_0)$ -t curves of formaldehyde and uridine. (a): Formaldehyde; (b): Uridine.

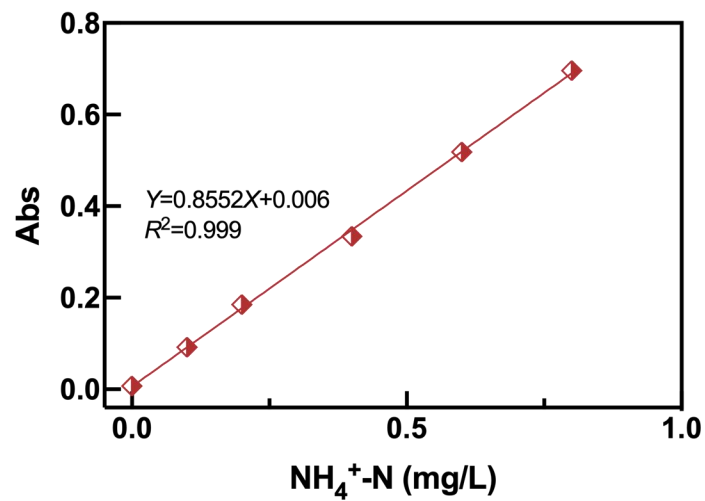


Fig. S4 Standard curve of salicylic acid hypochlorite spectrophotometry.

## References

Chen Y, Wang J, Chen B, Wang L (2019). A green and robust method to measure nanomolar dissolved organic nitrogen (DON) by vacuum ultraviolet. *Chemical Engineering Journal*, 363: 57–63