Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.


# Supporting Information

## Plasma synthesis of oxygen vacancy-rich $CuO/Cu_2(OH)_3NO_3$ heterostructure nanosheets for boosting degradation performance

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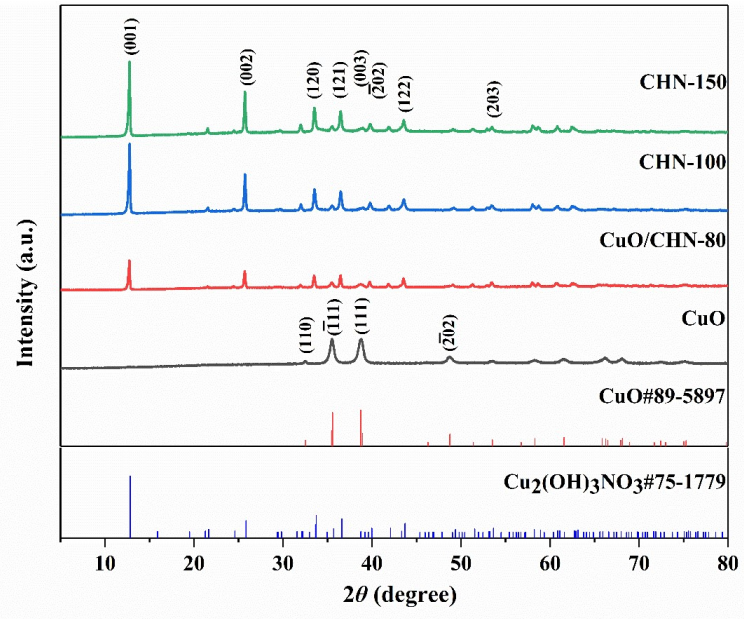


**Fig. S1** XRD spectra of the samples by DBD plasma treatment with different powers.

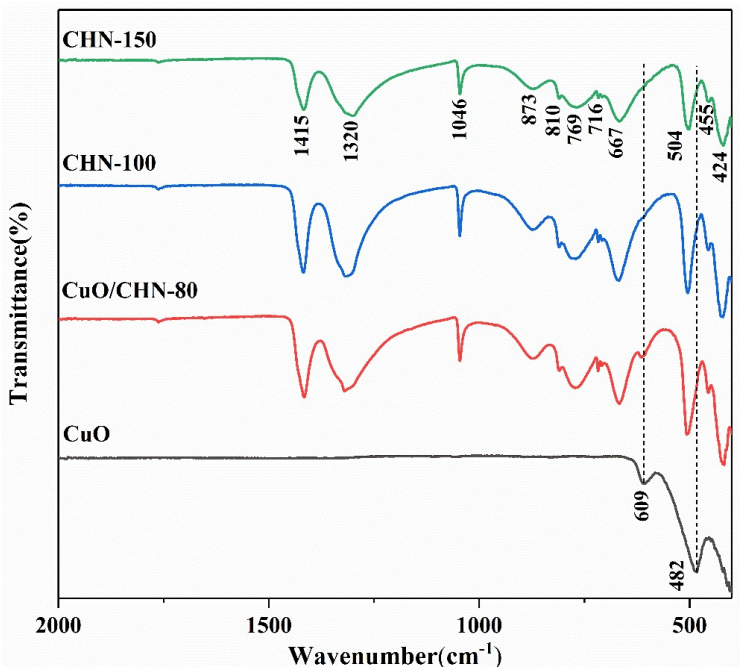


**Fig. S2** FT-IR spectra of CuO and samples at different plasma treatment powers.

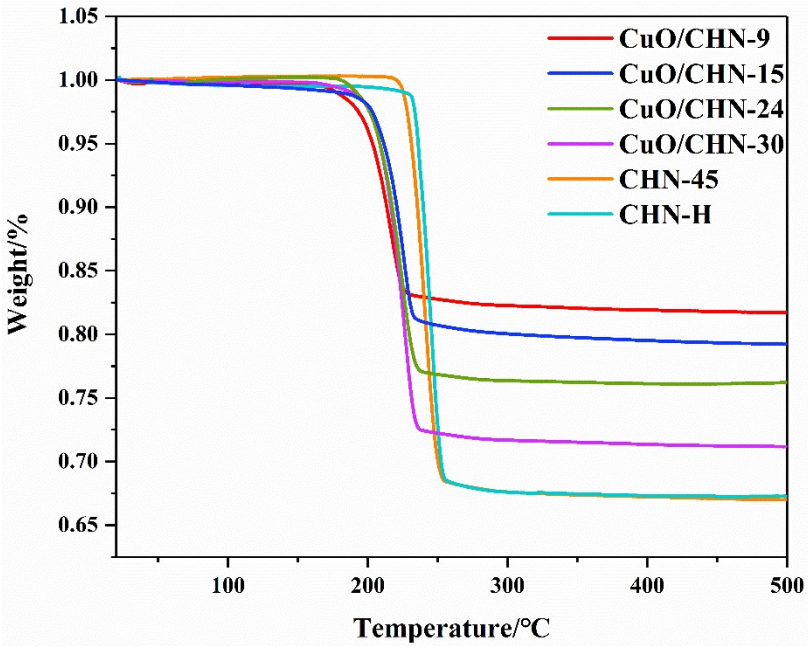


**Fig. S3** TGA curves for the samples.

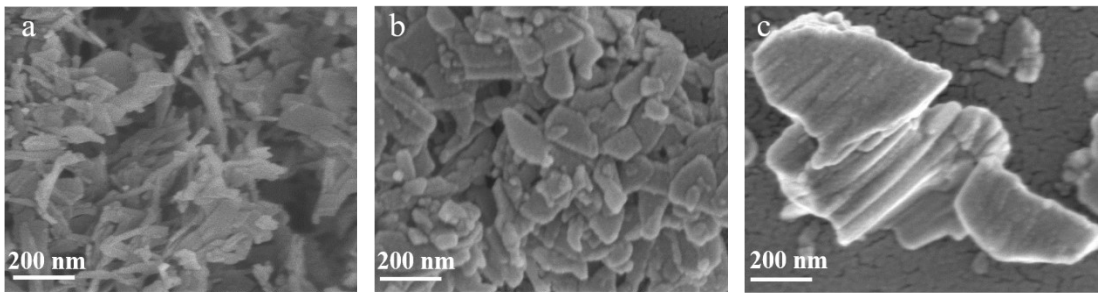


**Fig. S4** SEM images of the samples (a) CuO/CHN-80 and (b) CHN-100 and (c) CHN-150.

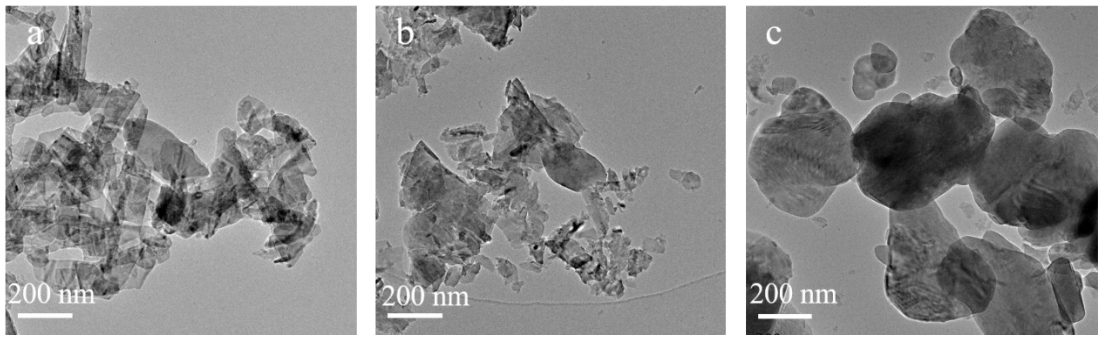


**Fig. S5** TEM images of the samples (a) CuO/CHN-80 and (b) CHN-100 and (c) CHN-150.

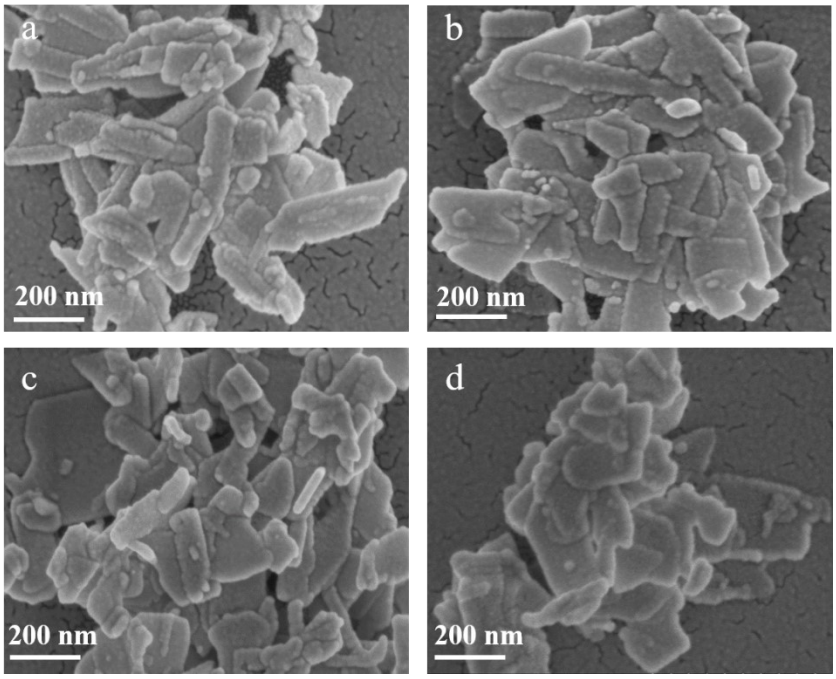


**Fig.S6** SEM images of the samples (a) CuO/CHN-9, (b) CuO/CHN-15, (c) CuO/CHN-30 and (d) CHN-45.

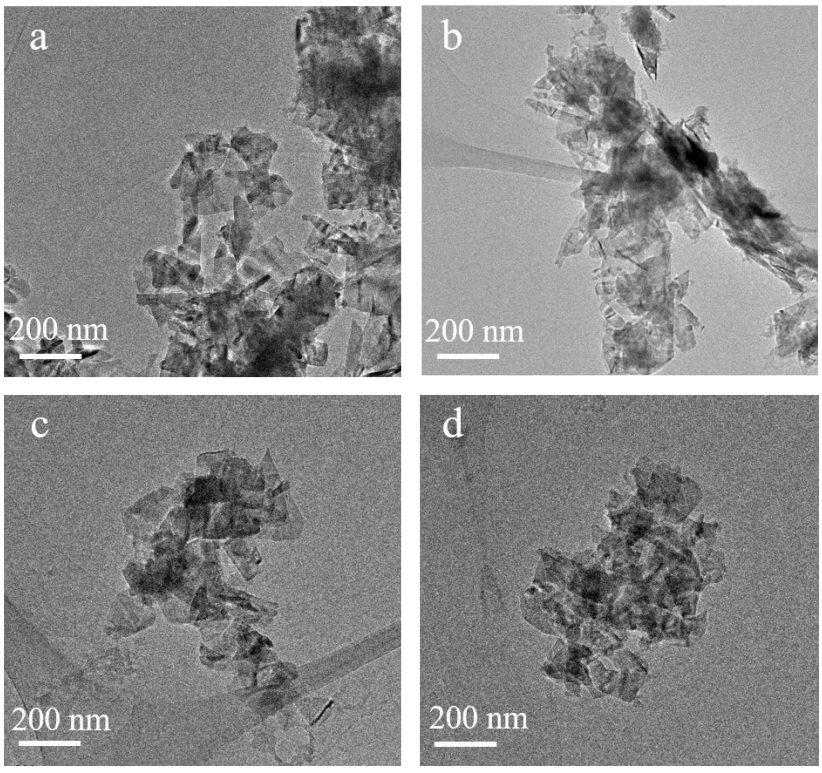


**Fig. S7** TEM images of the samples (a) CuO/CHN-9, (b) CuO/CHN-15, (c) CuO/CHN-30, (d) CHN-45.

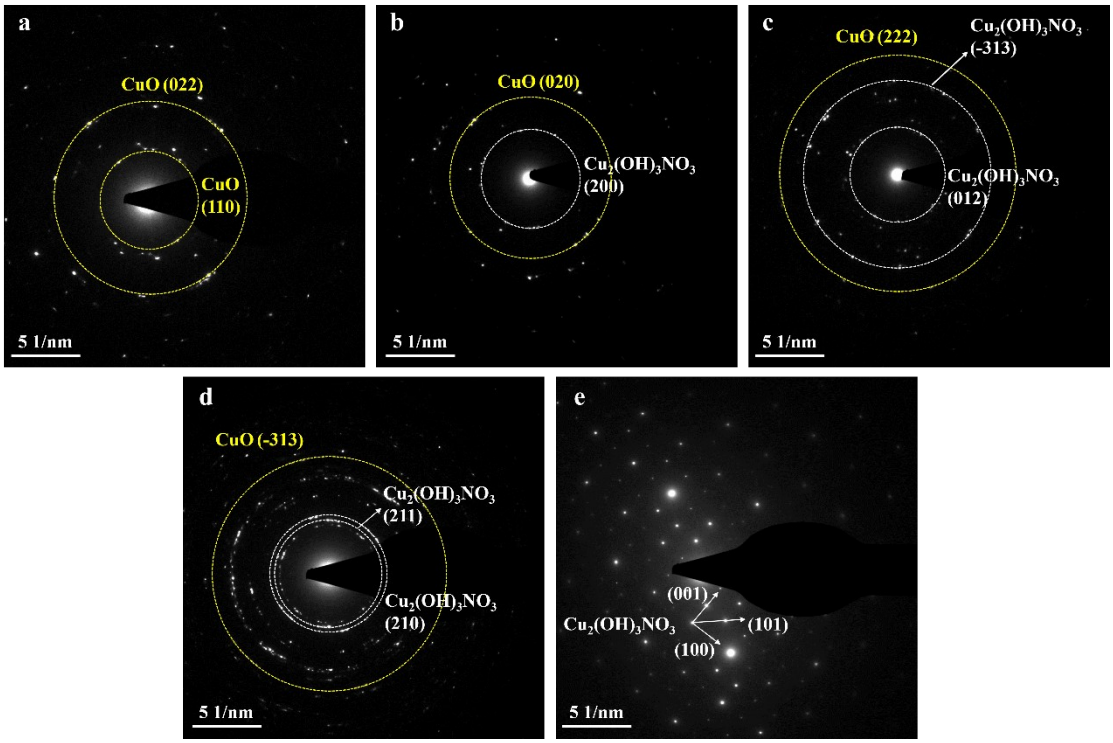


**Fig. S8** SAED patterns of the samples: (a) CuO, (b) CuO/CHN-15, (c) CuO/CHN-24, (d) CuO/CHN-30, (e) CHN-45.

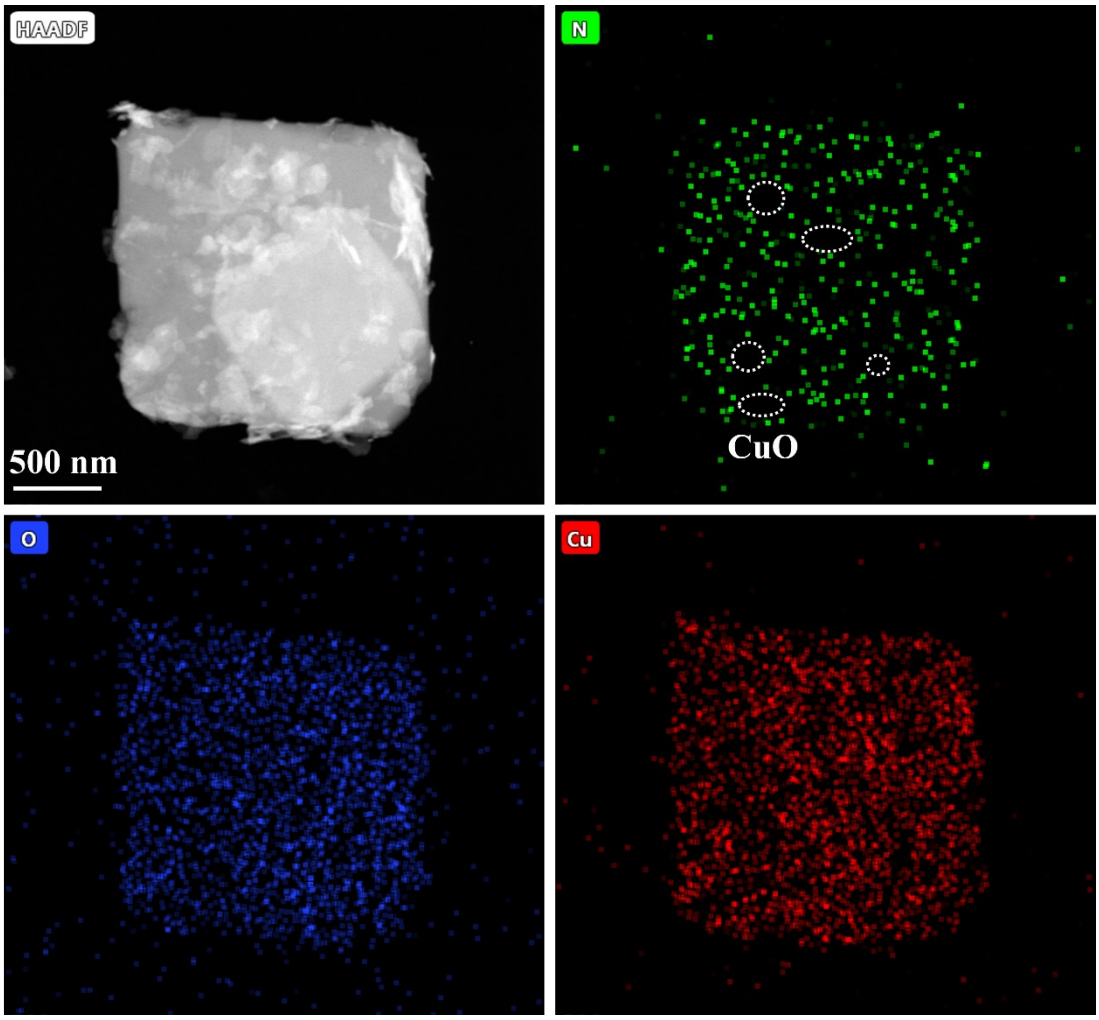


**Fig. S9** EDS elemental mapping images of CuO/CHN-24.

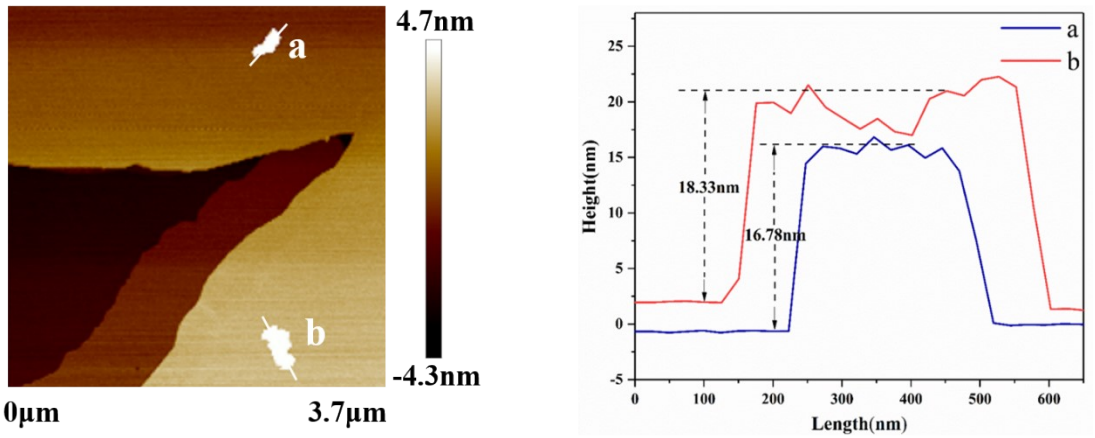


**Fig. S10** AFM images and corresponding height curves of CuO.

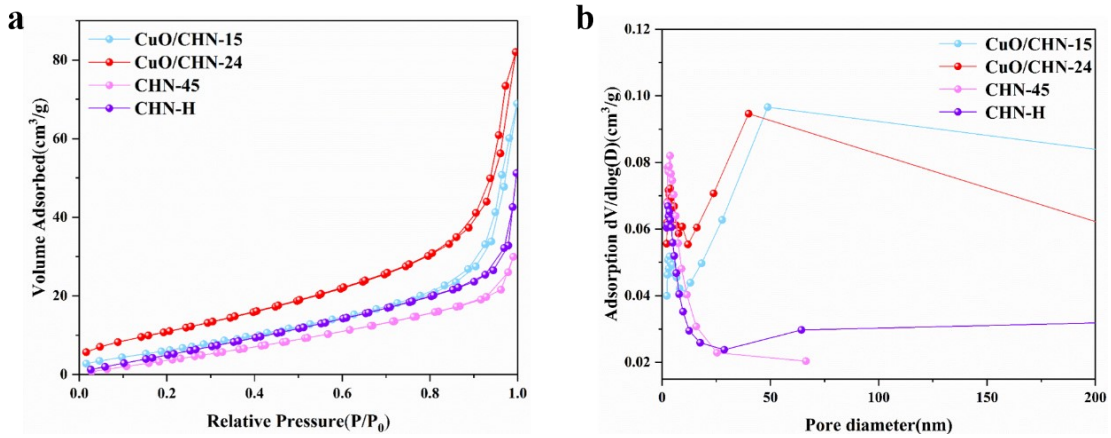


**Fig. S11** (a) $N_2$-adsorption/desorption isotherms and (b) pore size distributions of the samples.

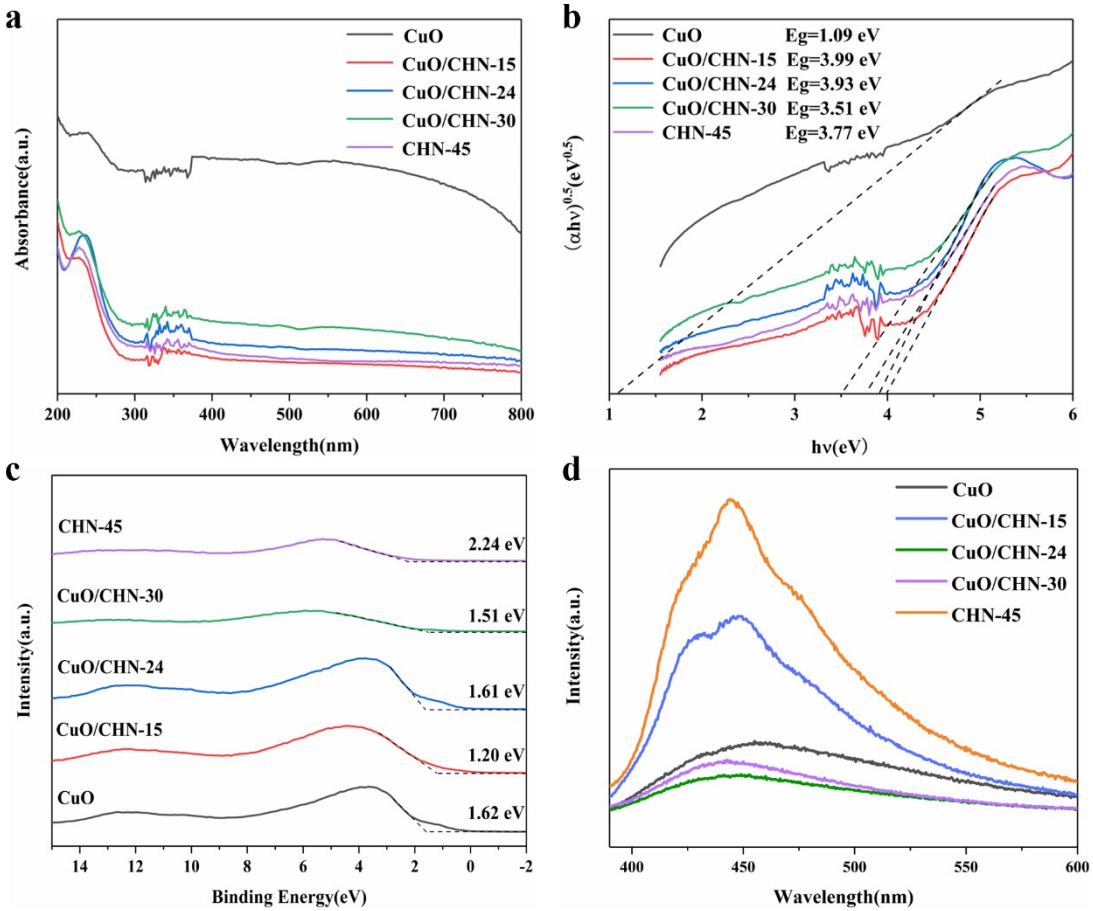


**Fig. S12** (a) UV-vis DRS spectra, (b) Tauc plots, (c) VB-XPS spectra, (d) PL spectra of Samples at different DBD treatment times.

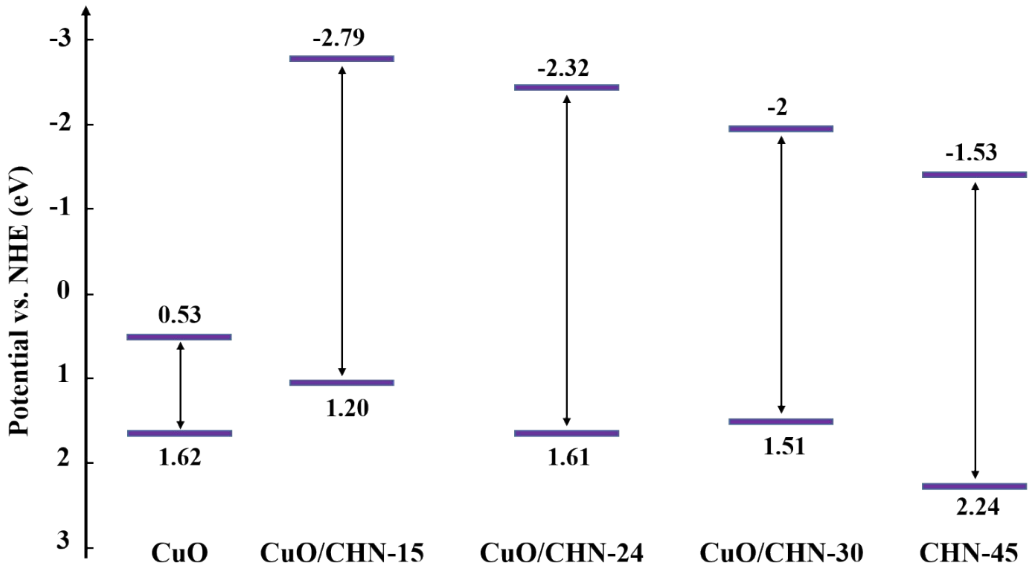


**Fig. S13** Energy band diagrams of the samples at different DBD treatment times.

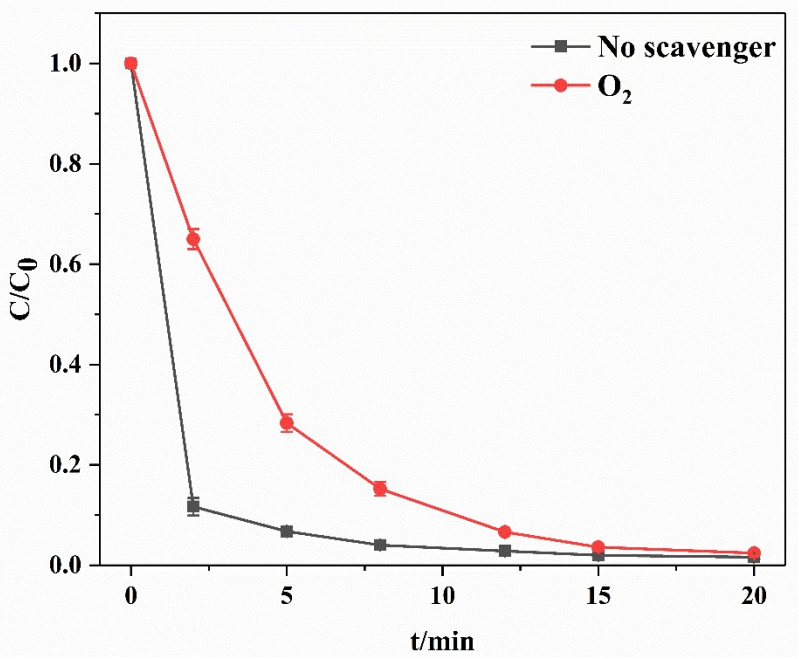


**Fig. S14** Degradation activity of CuO/CHN-24 under different oxygen vacancy conditions.

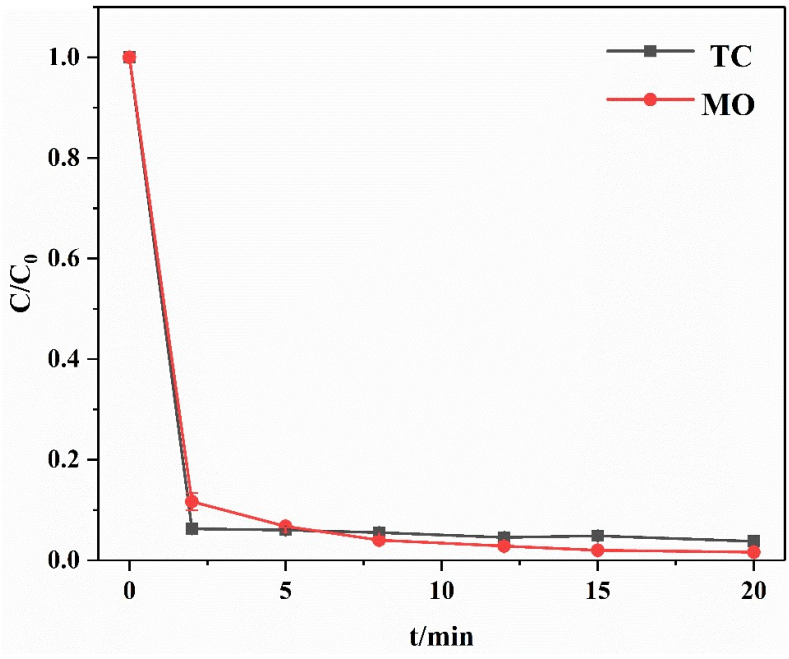


**Fig. S15** Comparison of the activity of CuO/CHN-24 in degrading different pollutants (catalyst=20 mg, pollutant=100 mL,20mg/L).

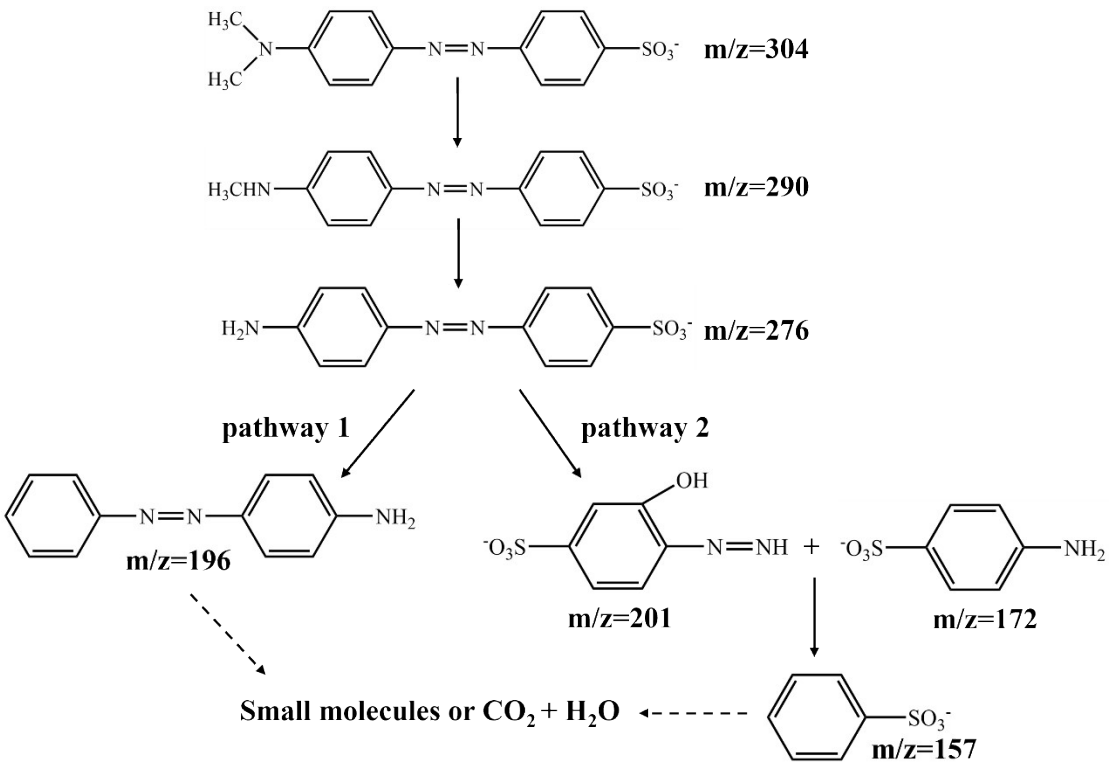


**Fig. S16** Proposed degradation pathways of MO in the $CuO/Cu_2(OH)_3NO_3$ system.

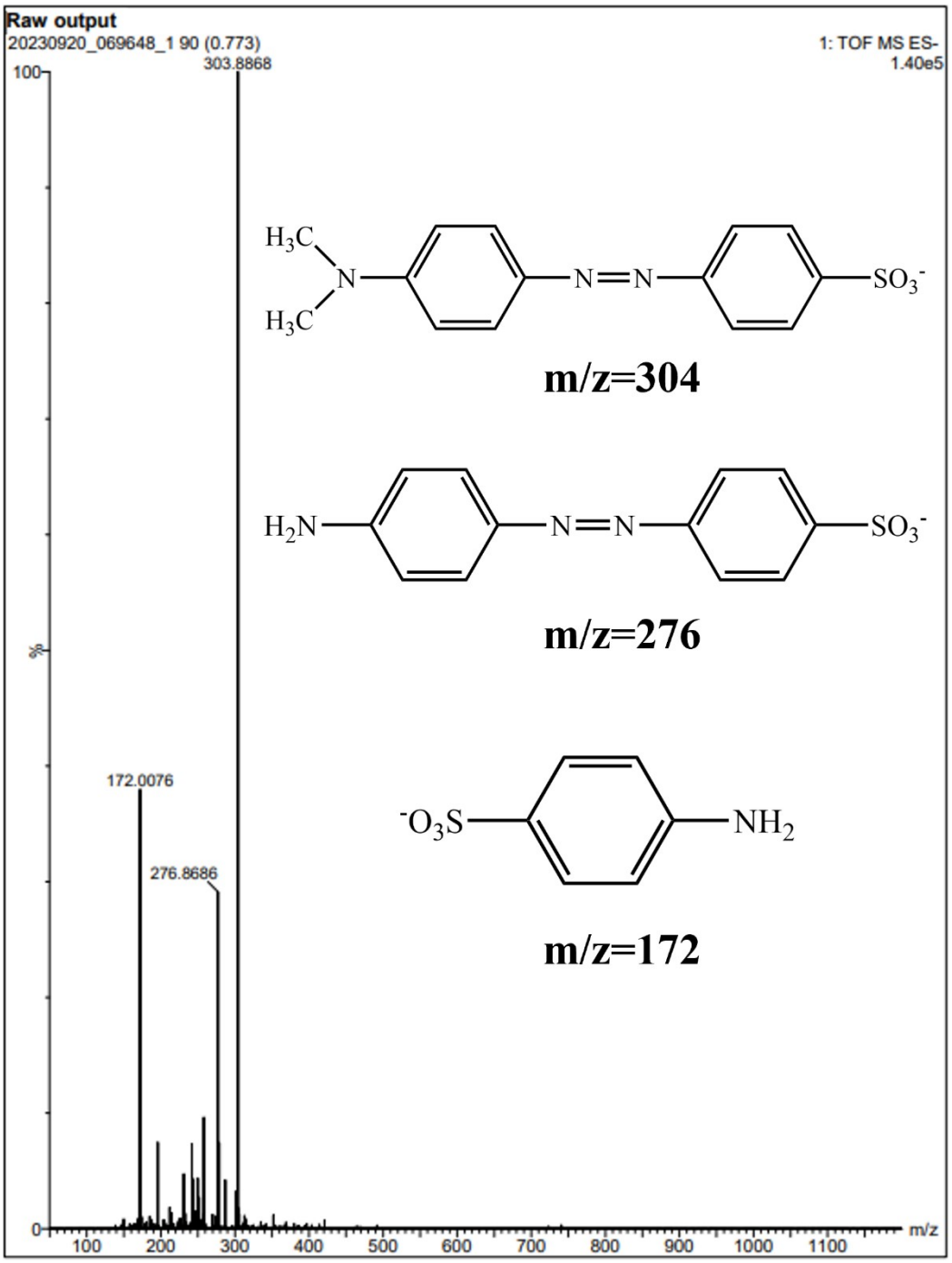


**Fig. S17** LC-MS spectra of intermediates corresponding to a degradation time of 2 min.

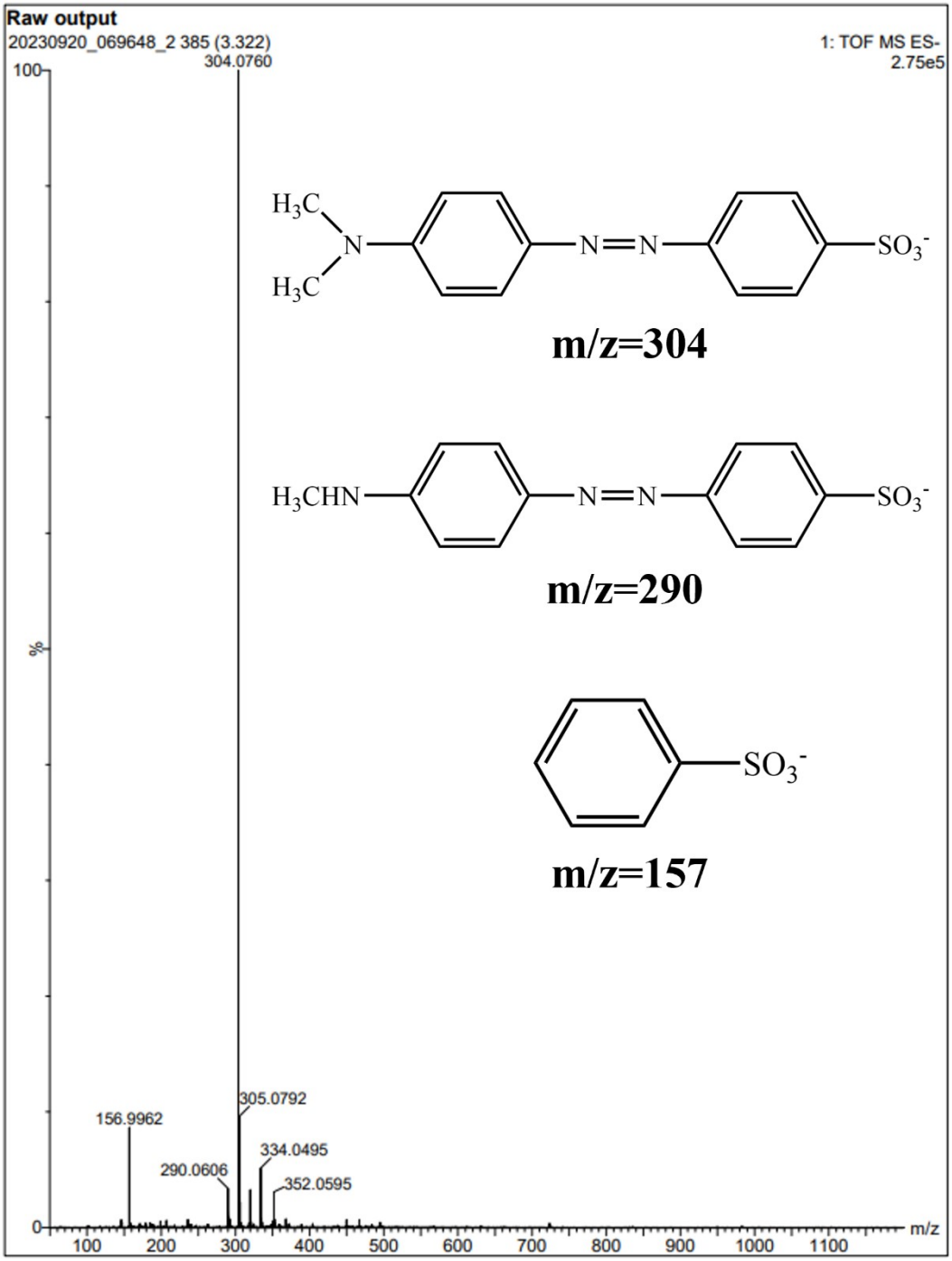


**Fig. S18** LC-MS spectra of intermediates corresponding to a degradation time of 5 min.

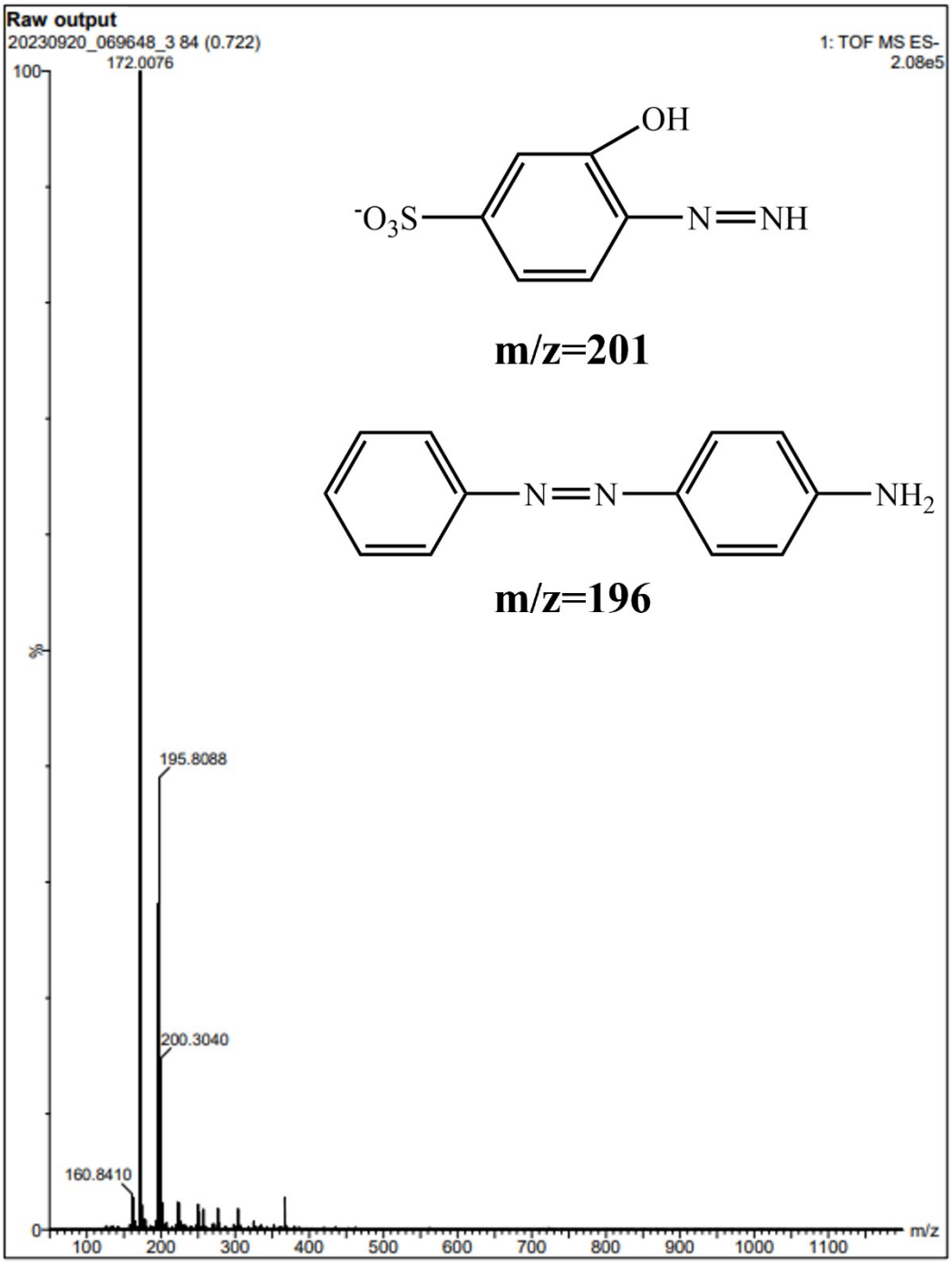


**Fig. S19** LC-MS spectra of intermediates corresponding to a degradation time of 10 min.

**Table S1** Mass fractions of CuO and $Cu_2(OH)_3NO_3$ in different samples.

| Samples | $Cu_2(OH)_3NO_3$/% | CuO/% |
|---|---|---|
| CuO/CHN-9 | 53.8 | 46.2 |
| CuO/CHN-15 | 60.2 | 39.8 |
| CuO/CHN-24 | 71.2 | 28.8 |
| CuO/CHN-30 | 85.4 | 14.6 |
| CHN-45 | 98.8 | 1.2 |
| CHN-H | 97.5 | 2.5 |

**Table S2** Specific surface area of the samples.

| sample | CuO/CHN-15 | CuO/CHN-24 | CHN-45 | CHN-H |
|---|---|---|---|---|
| $S_{BET}/(m^2 \cdot g^{-1})$ | 28.85 | 44.37 | 26.99 | 33.49 |
| Pore Volume$(cm^3 \cdot g^{-1})$ | 0.1066 | 0.1269 | 0.0463 | 0.0792 |

**Table S3** The atomic percent of different oxygen atoms determined by XPS.

| Samples | Atom percent (%) | | |
|---|---|---|---|
| | $O_{latt}$ | $O_v$ and $O_{O-H}$ | $O_{N-O}$ |
| CuO/CHN-15 | 16.32 | 30.49 | 53.19 |
| CuO/CHN-24 | 15.35 | 39.24 | 45.41 |
| CHN-45 | 0 | 40.36 | 59.64 |
| CHN-H | 0 | 60.97 | 39.03 |

**Table S4** Comparison of MO degradation activities of different catalysts.

| Catalyst | Degradation condition | Degradation time (min) | Degradation rate (%) | Ref |
|---|---|---|---|---|
| $CuO/Cu_2(OH)_3NO_3$ | [catalyst]=20 mg [pollutant]=20 mg/L CWAO | 8 | 96 | This Work |
| $TiO_2/Ti_3C_2$ | [catalyst]= 60 mg [pollutant]=20 mg/L 375 W Hg lamp | 40 | 99.6 | [1] |
| $In_2S_3$ | [catalyst]= 20 mg [pollutant]= 10 mg/L 300 W Xe lamp | 20 | 97 | [2] |
| $BaTi_{0.89}Sn_{0.11}O_3$ | [catalyst]=1 g/L [pollutant]=10 mg/L Piezocatalytic | 60 | 100 | [3] |
| $Ag@AgVO_3/BiOCl$ | [catalyst]=10 mg [pollutant]=10 mg/L solar photocatalysis | 50 | 100 | [4] |
| $Cu_2(OH)_3NO_3/ZnO$ | [catalyst]=0.4 g/L [pollutant]=15 mg/L CWAO | 20 | 97 | [5] |
| $Co_3O_4$-CuO | [catalyst]= 20 mg [pollutant]=20 mg/L ABET technologies solar simulator. | 120 | 79 | [6] |
| $g\text{-}C_3N_4/TiO_2/ZnIn_2S_4$ | [catalyst]= 30 mg [pollutant]=30 mg/L 300 W Xe lamp | 30 | 97.5 | [7] |
| Cu-FeOOH/TCN | [catalyst]=20 mg [pollutant]=40 mg/L 500 W Xe lamp | 70 | 97.8 | [8] |

## Notes and references


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