Electronic Supplementary Material (ESI) for Environmental Science: Nano.

Supporting Information

Accelerated alkaline activation of peroxydisulfate by reduced rubidium tungstate nanorods for enhanced degradation of bisphenol A

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Text S1. Effects of HCO_3^- groups.

The BPA degradation efficiency was dramatically decreased from 92.0% to 35.2% when HCO_3^- coexists in the alkaline rRT/PDS system. After further investigation, the HCO_3^- affects the reaction in the following two aspects. Firstly, the pH of the solution decreased to 9.3 after adding 50 mM HCO_3^- groups since HCO_3^- can react with OH^- groups to generate CO_3^{2-} and H_2O (Eq. S1). According to the result in Fig. 3a, lower pH will result in a decrease of BPA degradation. Hence the degradation efficiency of BPA was affected a lot. Secondly, HCO_3^- can quench $SO_4^{\cdot-}$ [1] and ·OH and generate $CO_3^{\cdot-}$ and $HCO_3^{\cdot-}$ radicals (Eqs. S2-S5) [2]. According to the previous study of Hu et al [1], $CO_3^{\cdot-}$ and $HCO_3^{\cdot-}$ radicals can also contribute to BPA degradation. Therefore, it would be hard to investigate the exact reason why the presence of HCO_3^- reduced BPA degradation in this reaction.

$$HCO_3^- + OH^- \rightarrow CO_3^{2-} + H_2O \tag{S1}$$

$$SO_4^{\cdot -} + CO_3^{2-} \rightarrow SO_4^{2-} + CO_3^{\cdot -} \tag{S2}$$

$$SO_4^{\cdot -} + HCO_3^- \rightarrow SO_4^{2-} + HCO_3\cdot \tag{S3}$$

$$\cdot OH + CO_3^{2-} \rightarrow CO_3^{\cdot -} + OH^- \tag{S4}$$

$$\cdot OH + HCO_3^- \rightarrow CO_3^{\cdot -} + H_2O \tag{S5}$$

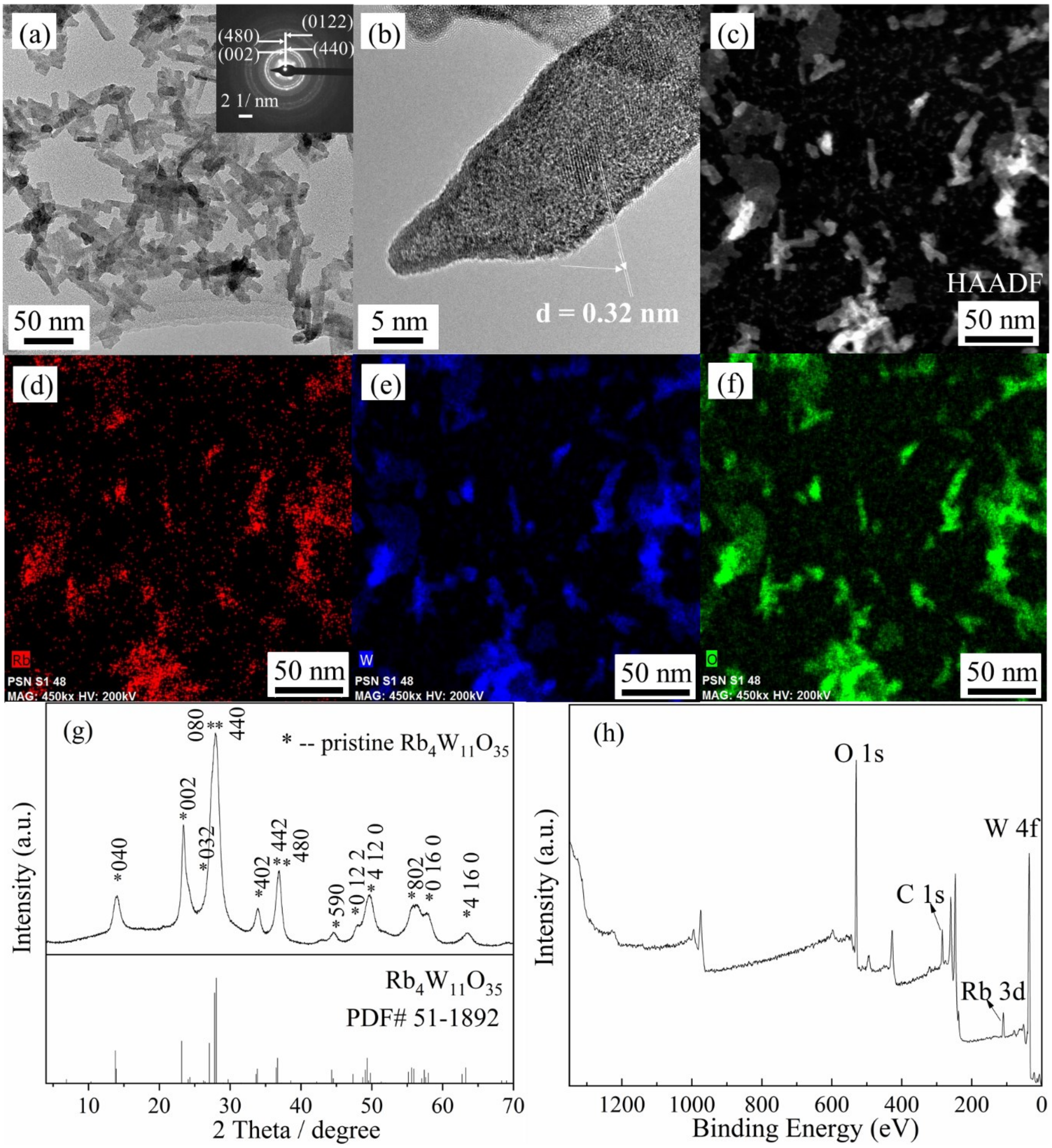

Figure. S1. (a) TEM and (b) HRTEM images of pristine $Rb_4W_{11}O_{35}$ materials. (c) HAADF-STEM image and (d) rubidium, (e) tungsten and (f) oxygen elemental mapping images of pristine $Rb_4W_{11}O_{35}$. (g) XRD pattern and (h) XPS survey spectra of the pristine $Rb_4W_{11}O_{35}$ nanorods.

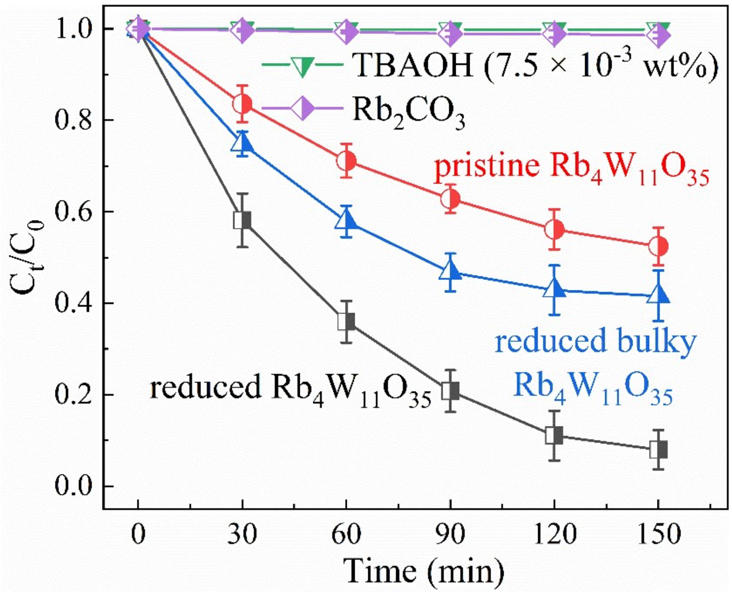

Figure. S2. The BPA removal efficiency by reduced $Rb_4W_{11}O_{35}$ nanorods, reduced bulk $Rb_4W_{11}O_{35}$, pristine $Rb_4W_{11}O_{35}$, Rb_2CO_3 and TBAOH. Reaction conditions: 2 µM catalysts, 20 mM PDS, 5 mg/L BPA, initial pH = 11.0, T = 293 K.

Table S1. Comparison of different catalysts for base activation of PDS.

Catalyst	Pollutants (mM)	PDS dosage (mM)	Catalyst dosage (g/L)	pH values	Time used for removal	Pseudo first-order rate constant (*k*)	R^2 values	References
$NaHCO_3$	Acetaminophen, 0.01	10	2.1	8.3	7 h, 70%	0.17 h^{-1}	-	3
Glucose	Nitrobenzene, 1	200	0.9	12.5	8h, 98%	-	-	4
$Mn_{0.6}Zn_{0.4}$-Fe_2O_4	BPA, 0.1	5	0.5	9.0	60min, 78%	-	-	5
Magnetite/Cu^{2+}	Anisole, 0.1	1.1	Magnetite- 0.5 Cu^{2+}-6.4×10^{-3}	11.0	22h,58%	-	-	6
Carbon nanotubes	Phenol, 0.1	1.0	0.1	11.0	60min, 90%	0.0146 min^{-1}	0.935	7
rGO-Ag0/Fe3O4	BPA, 0.01	1.0	0.1	10.0	3h, 20%	-	-	8
reduced $Rb_4W_{11}O_{35}$	BPA, 0.02 (5 mg/L)	20	5.8×10^{-3} g/L (2 μM)	11.0	150 min, 92 %	0.0173 min^{-1}	0.9957	This work

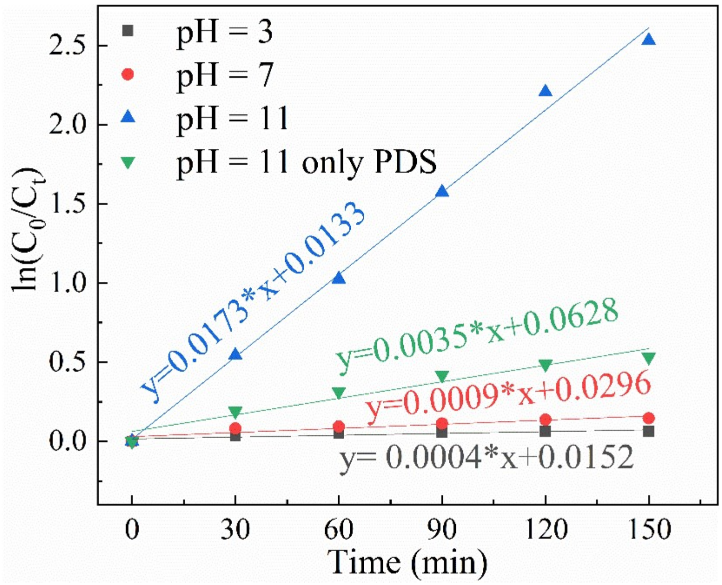

Figure. S3. Pseudo first-order kinetic curves of BPA removal under different initial pH values and conditions. Reaction conditions: 2 μM reduced $Rb_4W_{11}O_{35}$ nanorods, 20 mM PDS, 5 mg/L BPA, $T = 293$ K.

Table S2. Comparison of pseudo first-order rate constants under different initial pH values and conditions.

pH	Pseudo first-order rate constant (k_{obs}, min^{-1})	R^2 values
3	0.0004	0.8025
7	0.0009	0.8628
11	0.0173	0.9957
11 (only PDS)	0.0035	0.9458

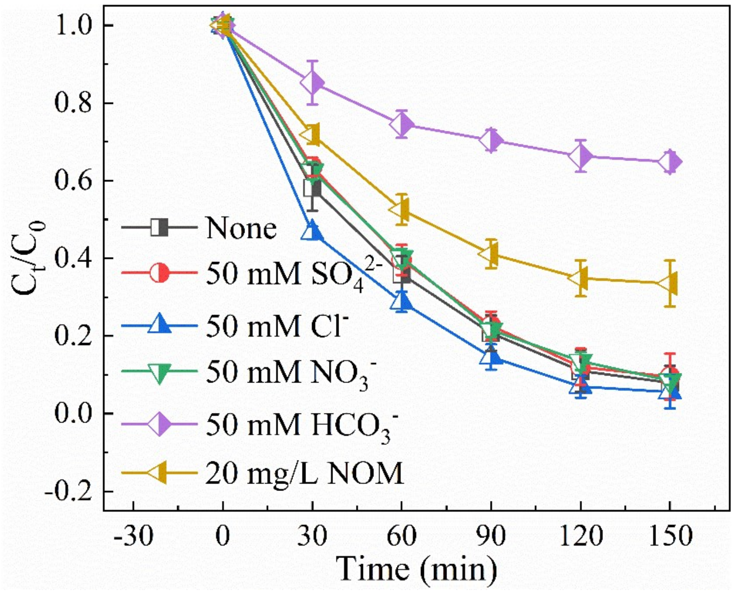

Figure. S4. Effects of inorganic anions SO_4^{2-}, Cl^-, NO_3^-, HCO_3^- and NOM on the degradation of BPA in the alkaline rRT/PDS system. Reaction conditions: 2 μM reduced $Rb_4W_{11}O_{35}$ nanorods, 20 mM PDS, 5 mg/L BPA, initial pH = 11.0, T = 293 K.

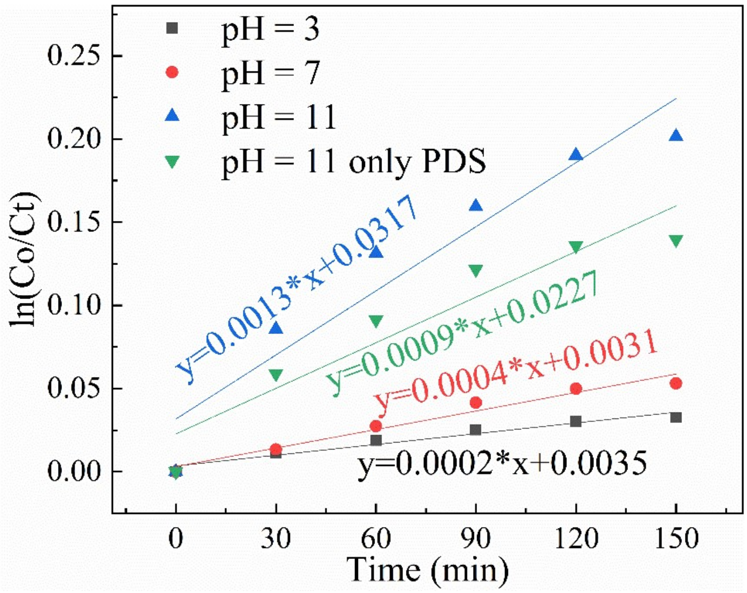

Figure. S5. Pseudo first-order kinetic curves of PDS decomposition under different initial pH values and conditions. Reaction conditions: 2 μM reduced $Rb_4W_{11}O_{35}$ nanorods, 20 mM PDS, 5 mg/L BPA, $T = 293$ K.

Table S3. Comparison of pseudo first-order rate constants of PDS decomposition under different initial pH values and conditions.

pH	Pseudo first-order rate constant (k_{obs}, min^{-1})	R^2 values
3	0.0002	0.9532
7	0.0004	0.9653
11	0.0013	0.914
11 (only PDS)	0.0009	0.8989

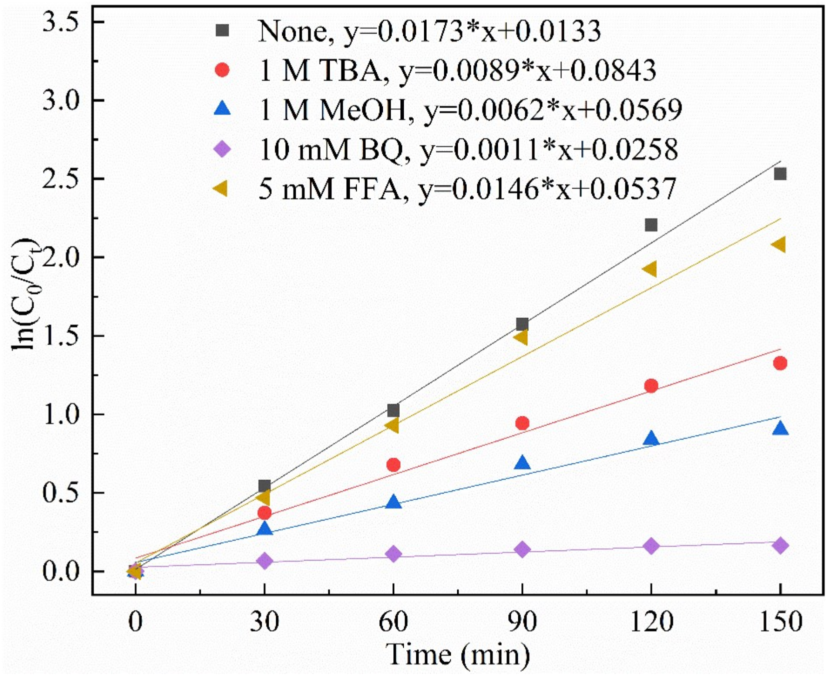

Figure. S6. Pseudo first-order kinetic curves of each quenching test. Reaction conditions: 2 μM reduced $Rb_4W_{11}O_{35}$ nanorods, 20 mM PDS, 5 mg/L BPA, initial pH = 11.0, T = 293 K.

Table S4. Comparison of pseudo first-order rate constants under different quenching tests.

Radicals Scavengers	Pseudo first-order rate constant (k_{obs}, min^{-1})	R^2 values
none	0.0173	0.9957
1 M TBA	0.0089	0.9809
1 M MeOH	0.0062	0.9724
10 mM BQ	0.0011	0.9025
5 mM FFA	0.0146	0.9826

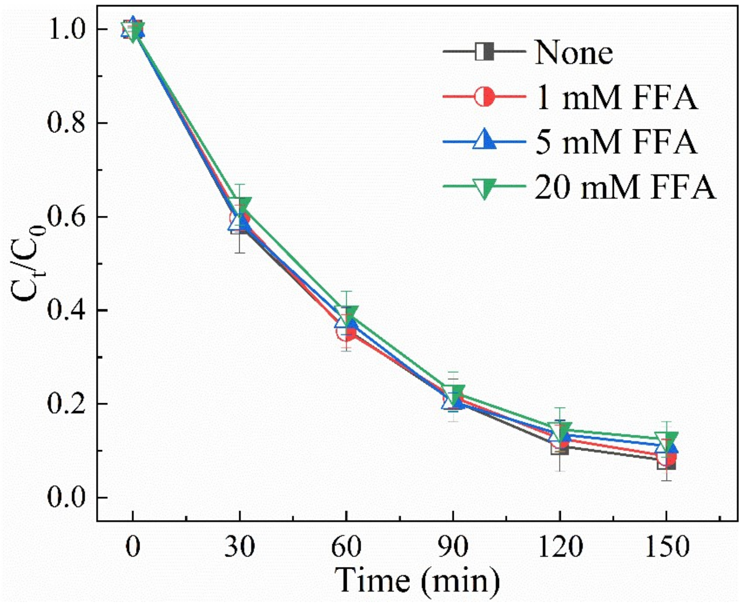

Figure. S7. Effect of FFA with different concentrations:1, 5 and 20 mM on the degradation of BPA. Reaction conditions: 2 μM reduced $Rb_4W_{11}O_{35}$ nanorods, 20 mM PDS, 5 mg/L BPA, initial pH = 11.0, T = 293 K.

References:

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